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Conducted by MAJOR B. BADEN-POWELL and E. S. GREW, M.A.

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The Conservation of Mass.

By ALFRED W. PORTER,

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THE principle which is the basis of all analytical chemistry is expressed by saying that whatever combinations or separations are effected in different materials the total amount of material present remains constant. The amount of material referred to in this statement is not measured by its volume; indeed, in many cases, this undergoes considerable change. The measurement is made by a balance, and the actual process of measurement consists in counterpoising the substances under examination—both in the free and combined states—against given "weights"; the "weight" so obtained is then taken as being a measure of the quantity of material present.

We are not now concerned with the illustration of this very familiar principle, nor with the question of its practical truth, which is undoubted. Every chemist trusts in its truth when he expects the results of his analysis to add up to 100 per cent. But as considerable interest is to-day felt in the possibility that the law is not completely satisfied, we intend to examine as simply as possible the experimental means by which its failure might be ascertained.

However, in the first place, it is important to have clear ideas as to what the problem really is. Some confusion of thought about it is prevalent. This confusion arises from the current confounding of mass and weight. Can we take the weight of a body as being proportional to the quantity of material in it? My housekeeper tells me it is so. Two pounds of sugar weigh twice as much as one, and there is twice as much sugar in them. Unquestionably so—from *her* point of view; but *we* must look at things a little more accurately than my housekeeper does.

When any material is placed in one pan of a balance it presses on it with a certain force. This force is said to be "due to gravity"—a statement, however, which does not add much to our knowledge. It would be much more explicit to say it is due to the earth; for there is every reason to believe that if the earth were to disappear the force would vanish too. It is this force which is scientifically defined as being the *weight* of the body. Now if anything has been proved with certainty, it is that the weight of a body is not always the same. Hang it on a spiral balance; the extension of the spiral spring is less if the experiment is made near the equator than near the poles. Or, better still (for a spiral spring is not very sensitve), place the body on one of the extremely ingenious spring balances which have been recently devised, and which consist simply of a horizontal fibre of quartz supported at one end—a cantilever, in fact. These are of wonderful sensitiveness and constancy also; the same force at the free end produces the same amount of bending every time. But a given fragment of material placed on it will produce a different deflection near the earth's equator than if the experiment is made near the earth's poles. It will be different if the apparatus is high up a mountain than at the sea-level. There is no constancy of *weight* even for the same body in the same state; this is acknowledged by all. So that, after all, it cannot be the weight that is being taken as a measure of the amount of material when the principle of the conservation of material is asserted to be true. The confusion arises from a peculiarity of the ordinary balance. The material is placed in one scale pan upon which it presses down. Weights (*i.e.*, standard blocks of material) are placed in the second pan, upon which they press down. If the two just counterbalance one another, and if the balance is accurate, they are said to be equal to one another. The comparison made here is between the turning power of two *weights*, and if the arms of the balance are of the same length, equality of turning power involves equality of the weights themselves. Even in the most accurate analyses, then, although it is the *weights* of the constituents of any body which are currently taken as being equal in the aggregate to the total weight of the body they compose, yet it must not be forgotten that all the weighings are made in the same locality.

Suppose now that the constituents are weighed on a sufficiently sensitive spring balance, and that some of them are weighed near the equator and some near the polar regions. If what we have said above about the variation of weight with positions on the earth is true, the sum of the separate weights will not equal the weight of the compound or mixture. The total weight of a body is admittedly not conserved, but depends upon the conditions under which it is weighed.

This variation cannot, however, be detected by an ordinary balance. Two weights that counterbalance at one part of the earth will balance everywhere else; in other words, though the pull of the earth on each undergoes variation, it varies in the same proportion for each; and, consequently, if they are equal anywhere, the equality is universal. It is this peculiarity of an ordinary balance which has led to the popular notion

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that the amount of material in a body can be measured by its *weight*. If any other kind of sensitive balance had been employed it would soon have been realised that this is not legitimate unless it be assumed that the quantity of material in a body varies according to the part of the earth on which it happens to be placed.

If weight, then, is not a satisfactory measure of the quantity of matter in a body, can we find any property that is?

If we were concerned only with matter of the same chemical kind—for example, iron—and exactly the same in all respects except that there was a bigger volume of one than of the other, nobody would hesitate to measure the quantity by volume. Matter would be bought by the cubic centimetre, or cubic foot, or the quart. Two quarts would always represent twice as much matter as one. But the world is "full of a number of things," and it is not easy to explain exactly what you mean if you say that there is as much material in a certain volume of water as in a certain block of lead. What is the criterion of equality in such a case as this when the material is of different kinds? In commerce, a certain volume of iron is given in exchange for a much smaller volume of gold. In some sense, then, these different volumes are taken as being a measure of equivalent quantities of the two materials; and if a fixed relation were preserved between these quantities, a perfectly sound scientific system could be founded on such a basis of equivalence. But familiarity with market fluctuations would soon breed contempt for such a system; it would be absolutely of no use for scientific purposes. It has been agreed to measure quantity of material not in the commercial way; not even by its weight, which is nearly satisfactory; but by another dynamical way, which, at any rate, till recently, was thought to make the principle of the conservation of material precisely true under whatever circumstances the quantity of matter is measured.

We will explain this method.

When Sir Isaac Newton thought out his Laws of Motion, he perceived that every change of motion is brought about by the influence of one body upon another, and, moreover, that this influence is a mutual one. When two billiard balls strike, the velocity of *both* is changed; each influences the motion of the other. A horse gives motion to a cart, but the cart simultaneously retards the motion of the horse. The main part of the motion of the moon is controlled by the influence of the earth, and reciprocally the moon modifies the motion of the earth.

Think now only of the simplest possible case, viz., that in which the mutually influencing bodies move along the same straight line; two billiard balls, for example, moving without spin. When they strike, the speed of one is increased and that of the other is then always retarded. Measure, or (since this is not always easy to do, and we do not wish to introduce here the complications of actual measurements) imagine measured, the *change* of velocity of each. The ratio of the changes, so far as all experiment has succeeded in obtaining it, is the same for the same two bodies whatever the previous velocities may have been. For two billiard balls it would usually come out as numerically equal to unity; whenever it does so *the masses of the influencing bodies are defined as being equal*. If the ratio of the changes of velocity is not unity, the *ratio of the masses of the two bodies is defined as being* INVERSELY *as the ratio of the changes of velocities, whatever it may be*. For example, if the balls be called A and B, and A increase its velocity (due to the influence of B) from 4 to 10 units, while B *diminish* its velocity (due to the influence of A) from 6 to 2 units, we have

$$\frac{\text{Increase of velocity of A}}{\text{Decrease of velocity of B}} = \frac{6}{4} = \frac{\text{Mass of B.}}{\text{Mass of A.}}$$

Hence in this hypothetical case B has $1\frac{1}{2}$ times the mass of A, and no matter what the circumstances of the influence may be, this relation is found to be constant for the same two bodies A and B; for example, if A's velocity increase by 12 units due to B, then B's will decrease 8 units due to A. The more massive body has its velocity changed to the less degree; hence, mass, as we have defined it, is a measure of the reluctance of the body to be disturbed. A fly alighting on a cannon ball scarcely affects the motion of the latter; a cannon ball striking a fly sweeps it apparently irresistibly before it. In each case the motion of the ball is changed but little because its mass is so enormous in comparison with that of the fly.

The supposed constancy of the mass of a body under every condition makes the mass an eminently suitable means of measuring the quantity of material in it, and is universally adopted as such. Thus, in the example given above, B is said to contain $1\frac{1}{2}$ times as much matter as A. This mode of measuring matter corresponds to considering the quantities equal when the same kind of substance is present in equal volumes; but for different kinds of substances the quantities may be equal when the volumes are very different. A cubic foot of lead has about 11.35 times as much matter or mass in it as a cubic foot of water.

In a later number we will show the relation between mass and weight, and we will then be in a position to explain the nature of the evidence that has in recent years been brought forward in the endeavour to prove that the principle of conservation is not precisely true.

The Radio-activity of Chemical Reactions.

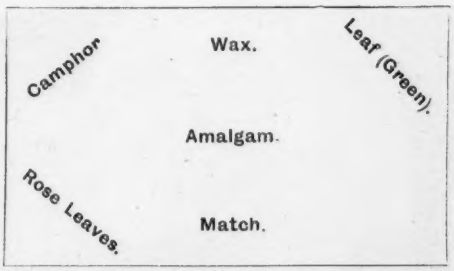
By A. F. Burgess and B. Ingram, B.A., F.C.S.

It is, of course, a well-known fact that every chemical reaction is attended by the evolution or absorption of energy in some form or another. That a chemical equation does not adequately represent a chemical reaction has recently been further attested by the work of Colson, who has found that when a supersaturated solution of sodium sulphate is made to crystallize it gives out n_1-rays. A mixture of aluminium, sulphate, and potassium sulphate does not give out n_1-rays until crystallization (*i.e.*, with formation of alum) is started.

Much interesting research has been done on this subject, and the more substantial proof has been supplied by Landolt and Heydweiler, who have succeeded by means of a balance of high precision in detecting losses in chemical reactions by radio-activity. In fact, the discrepancies, which Stas constantly encountered in his weighings when engaged in his classical research on the "Indestructibility of Matter," may now be satisfactorily accounted for on the proof that, in chemical processes, the loss is due to certain emanations.

Our first experiment (which was entirely speculative) consisted of placing in a light-tight box the

following substances arranged in the positions as shown in the diagram. These were covered by a sheet



of ordinary note-paper, and on the top was placed (film downwards) a photographic plate. We left it from July 28 until September 6 (40 days).

Fig. 1.—July 28-Sept. 6, 1904. 40 days.

It will be observed that the general illumination comes from the centre of the plate directly over the sodium amalgam into which water had been allowed to trickle. The obstacles were pieces of plain and perforated zinc, copper, and tinned iron. In order to investigate the cause of this action we exposed our materials for a period of twenty-one days to the radio-active effects of gas mantles, and then tried their effect, as before, for ten days (September 6 to September 16). When the plate was developed it appeared quite clear. Incidentally we observed that unused gas mantles have precisely the same effect as the used gas mantles.

Our next experiments were conducted in an iron box, blackened and made thoroughly light-tight. A section through the apparatus is given in Fig. 2.

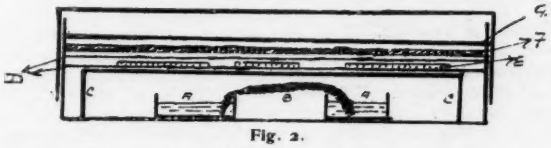


Fig. 2.

A, vessels containing chemical reagents.
B, wool connecting them.
C, iron support.
D, note-paper.
E, obstacles.
F, plate (protected) with film downwards.
G, thick sheets of red paper.

Our first experiment with the zinc-copper couple beneath the support C produced the accompanying result (see Fig. 3). The exposure lasted eleven days

Fig. 3.—Sept. 20-Oct. 1, 1904. 11 days. Cu-Zn in Sulphuric Acid.

(September 20-October 1). Both the pieces of zinc have become sources of light, thus producing an effect entirely different from our other results.

It may be stated here that the pieces of zinc used had not been in use before for any previous experiments. After an exposure of thirteen days phosphorus in water gave no result whatever. Our next plate is the result

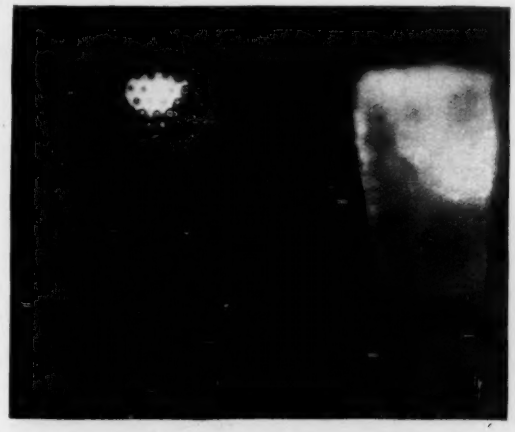


Fig. 4.—Sept. 23-Oct. 3, 1904. 10 days. Ammonia and Hydrochloric Acid (fuming).

of exposure to fuming ammonia and hydrochloric acid. In spite of our precautions to the contrary the liquid managed to crawl up to the plate and affect it as shown above.

It then occurred to us to try the effect of a double reaction, such as takes place when calcium carbide is treated with water.

$$(1)\ CaC_2 + H_2O = CaO + C_2H_2$$
$$(2)\ CaO + H_2O = Ca(OH)_2$$

After an exposure of only two days the plate was developed with the accompanying result. The light portion was the part immediately over the vessel containing the calcium carbide. The lines were on the

paper in which the photographic plate had been wrapped. Another piece of perforated zinc served as the obstacle. It can be faintly seen with the shadow of the iron support running across it almost parallel to the edge of the print.

We next tried the effect of rapidly evaporating some ether in our apparatus. We used a piece of bromide

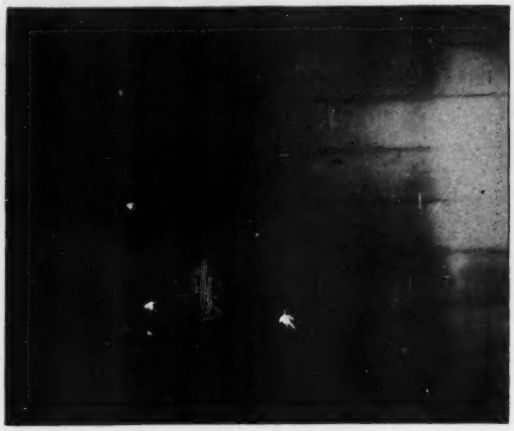


Fig. 5.—Oct. 8-10, 1904. 2 days. Calcium Carbide and Water. Obstacles: Zinc (one piece plain, one perforated).

paper, carefully protected* from actual contact with the vapour, and placing a penny as the obstacle, we endeavoured to obtain an "instantaneous" photograph by a three-hours' exposure.

Fig. 7 shows most clearly the effect of a chemical reaction. Here the piece of perforated zinc can be

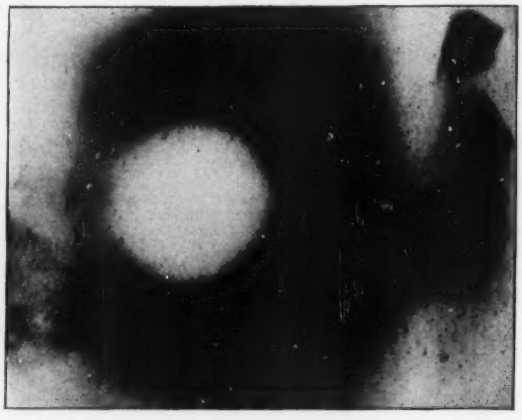


Fig. 6.—Oct. 4, 1904. Exposed for three hours to ether vapour. Obstacle: Penny.

plainly distinguished *through* the iron arm of the support. The obstacle on the right is a plain piece of zinc. The plate is the result of the slow decomposition of hydrogen peroxide, $H_2O_2 = H_2O + O$, lasting over a period of thirteen days.

Our last effort was to expose a plate to some eucalyptus oil for a period of thirteen days.

* Ether blackens bromide paper on development.

We are not aware that any chemical change goes on when this oil is left alone, nor could it have evapor-

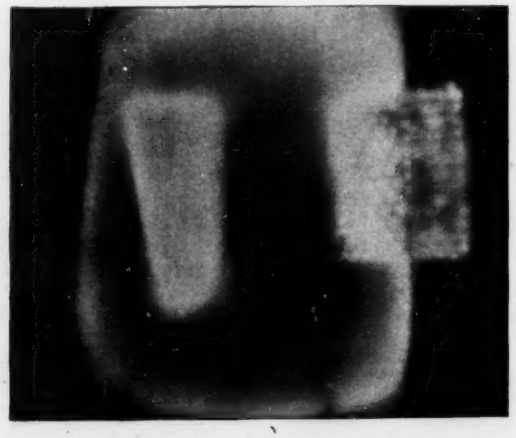
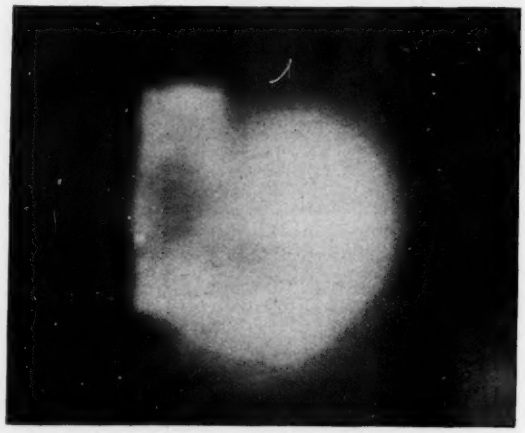


Fig. 7.—Oct. 8-21, 1904. 13 days. H_2O_2.

ated to any extent, seeing that the box was closed the whole time; yet the plate shows some action of some



Oct. 8-21, 1904. 13 days. Eucalyptus oil.

kind, and we leave it to the efforts of the readers of "KNOWLEDGE" to suggest a satisfactory explanation.

NOTE.—Will Mr. A. F. Burgess communicate his address to the Editor.

Spectrum Analysis.—It is not quite easy to classify "An Introduction to Spectrum Analysis" (Longmans, Green), by Dr. Marshall Watts, which is something between a text-book and a work of reference. Perhaps its best title is the one that has been found for it; and it may be confidently recommended to students who wish to take up the study of spectroscopic methods from the beginning. It is divided into two portions; the first of which describes spectroscopic work and discusses the uses of instruments; the Fraunhofer lines of the solar spectrum, the meanings and implications of the "Zeeman Effect," and of observations in stellar spectroscopy generally; the Michelson echelon diffraction grating; and the work of Professor Hale with the spectro-heliograph. The second part of the book embraces some hundred and eighty pages of catalogue of spectra.

The Vital Earth.

By Grenville A. J. Cole.

The slowness of the processes of mountain-building and denudation, the coldness of common rock, and the manifold signs of activity, on the other hand, in the organic kingdoms, have conspired to make us regard our planet as a dead mass, the destiny of which is now concentrated in that of the human race.

There is no doubt that man and his movements have the supremest interest for ourselves. Ethnographers have discussed the influence of environment, and have seen the geographic cradle, as it were, reflected in the characters of a tribe. But, again and again, the migrations of peoples, with customs and manners ready formed, have shown us that man may finally impress himself on his new surroundings, instead of being forced into their mould. Our prevalent classical education, moreover, ignoring natural phenomena on the one hand, and the long struggles of prehistoric man upon the other, tends further to fix our attention on the dominant position that we have attained.

But is the earth on which we move so very lifeless after all? If we construct a diagram to show how much of this ball, 8,000 miles across, is accessible to our direct enquiries, we are at once brought face to face with the enormous possibilities of the interior. We are familiar with the circulation of water, for example, between the atmosphere and the uppermost and disintegrated layers of our rocks; but we may well ask if all the water, and all the gases, were successfully extruded at the period of the consolidation of the crust. This period, again, is still in progress; the crust is far from stable, and grows by additions from below. Substances, till now occluded, may be given out, when passage is afforded to them during the movements of the upper layers; others may become incorporated in the crust, and may ultimately be brought within our reach, in their later modifications, upon the surface.

Prof. Suess, of Vienna, has recently pressed home upon us the distinction between permeating superficial fluids, as defined by Posepny, and those that are in reality nascent and come to us from below. We still meet in newspapers, and in many scientific text-books, the theory that the waters of volcanoes originate from inroads of the sea; and the influence exercised by this view is emphasised by the clearness with which Prof. Suess has found it even now necessary to stand out against it. "The steam of volcanoes," he says,* "cannot arise from infiltration from the surface, and such infiltration is clearly out of the question in the case of the carbon dioxide. Whence, then, do these substances arise? They proceed from the deeper inner regions of the globe, and are the outward signs of that loss of gases, which began with the first consolidation, and which is not completely over, though localised at certain points and lines. In this way the oceans and the whole superficial (*vadose*) hydrosphere became separated from the body of the globe. Volcanoes are not fed by infiltrations from the sea, but the seas increase in volume as the result of each eruption."

* "Ueber heisse Quellen," Address to the Society of German Naturalists and Doctors at Karlsbad, 1902 (*Prometheus*, XIV., 1903, p. 226).

Suess points out that this proposition is not new; yet it needs repeated affirmation. From some points of view, in fact, the interior of the earth, with its concentrated metals under high temperatures and pressures, is still young and potent, a planet still capable of giving off light-rays of its own, were its stony envelope removed. The incandescent glow of the material ejected from volcanoes brings us, as Tschermak has indicated, near to the cosmic forces that are common to the systems of the stars. The liberation of gases and "emanations" in the past is no real measure of what remains occluded in our own day. Combinations, moreover, may be possible at the existing high temperatures in the interior, which lower temperature and relief from pressure may in time convert into other and even startling forms.

The object of the present paper is to ask for a suspension of judgment in regard to several questions which geological instructors are apt to pass over as well proven. A wise review of this matter appears in the last edition of Sir A. Geikie's "Text-book of Geology" (1903, pp. 351-8), where many useful references to published papers will be found. We gain new interest in the water that permeates volcanic rocks from the amazing eruptions of Martinique and Saint Vincent in 1902. The stories of poisonous gases and fiery exhalations soon gave way before scientific examination; the burning and scorching effects proved to be due to hot volcanic dust, sent forth in such quantities as to practically exclude the common air. No flame or ordinary combustion was possible until the dust-cloud relaxed its first closeness and intensity. Moreover, its very texture and continuity seem to have been due to the evolution of water-vapour from each of the myriad particles that were ejected simultaneously from the vent. But it is difficult in such catastrophic examples to realise what is actually going on, and what gases are being liberated so abruptly from the parent earth. The study of the vapour-jets and hot springs that remain in volcanic areas for centuries after activity in the ordinary sense has passed away, has given us an impressive picture of the immense streams of matter passing from the inner rocks into the hydrosphere. The prevalence of carbon dioxide is especially striking. Not only at the famous Grotto del Cane near Naples, but at the far more accessible Grotte du Chien at Royat in the Department of the Puy-de-Dôme, we may become immersed in a bath of this dense gas as it oozes from the pores of solidified volcanic ground. The opening of a bottle of natural mineral water, though the "sparkle" in different species occurs in very different degrees, brings us into touch in a more homely way with the unexhausted vitality of the earth. Probably no one attributes the carbon of the gaseous compound thus brought to the surface to the decay of ancient vegetation within the crust. Yet the case of petroleum is probably similar; and here the material is generally referred to as of an organic origin. A combustible material, however strange its mode of occurrence and emanation, seems to suggest from the outset fossil forests and old swamps, and it is almost impossible to persuade "practical men" that carbon exists in the earth apart from coal-seams. The very fact that petroleum is in some cases successfully distilled from Carboniferous shales is, moreover, commonly held to prove its organic origin in all areas. Carbon and carbon-compounds, however, must have existed on our globe long before living things arose upon the surface, and it is no mere speculation to suppose that much of the material remained unavail-

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able on account of its combination with metals in the hidden depths.

The occurrence of graphite offers many interesting suggestions. In Siberia and in the Western Alps, beds of graphite may be traced into strata that retain recognisable vegetable remains. Weinschenk*, who has given special attention to this matter in recent years, believes that the graphitic anthracite of the Alps—which one may see, for example, collected for fuel on the summit of the Little St. Bernard—passes into graphite as the result of the intrusion of the adjacent granite. In the Archæan region, however, of the frontier of Bavaria and Bohemia, Weinschenk† finds no sign of an organic origin for the beds and lens-like masses associated with the ancient gneiss. He urges that the graphite is here deposited from gaseous exhalations, which were connected with the inflow of granite in the area. Gruner's experiments on carbon monoxide in 1869 lead Weinschenk to regard this gas as a very probable source of carbon in the gneisses. It appears that iron ores at 300° C. decompose carbon monoxide with deposition of graphite; the little known metallic carbonyls, moreover, may also be looked to as furnishing carbon in a volatile form. Such substances, with carbon dioxide and water, are pictured as saturating the rocks in contact with the invading mass, and as taking advantage of any planes of easy penetration, during the folding of the ancient series. Mica-schists, with the easy partings offered by the prevalent mineral, might thus become impregnated in a special degree; while cavities provided by earth-movements would serve as chambers of deposition. As years go on, we shall probably learn more and more of the products yet to emerge from the earth's unknown interior. While we are on the verge of gaining some ideas on elemental transmutation, we may even look forward to the exhalation in due time of substances unknown to us in our present geological age. Time may be an important factor in the internal processes of our vital globe; and who shall say that senility has yet set in? Is it not at least a fair speculation that life itself may be a phenomenon expressing a particular phase in the history of our globe? Life may not be a merely external reaction, limited by temperature, and controlled by cosmic law upon a cooling and indifferent planet. May we not in time see some return towards the conception of the great Earth-mother, fostering her children from within, stimulating them daily against attack, reviving them, perhaps, in hours of danger, and fitting them to cope with future changes by changes in her own heart's core?

* Abhandlungen der k. bayer Akademie der Wissenschaften II. Cl., XXI. Band, 1900.

† *Ibid.*, XIX. Band, 1897.

Awards to the Wellcome Chemical Research Laboratories, London.

THE Committee on Awards of the Louisiana Purchase Exposition, St. Louis, have conferred upon the Wellcome Chemical Research Laboratories the distinction of a grand prize and three gold medals, in recognition of the importance and educational value of the chemical and pharmacognostical researches conducted in these laboratories under the direction of Dr. Frederick B. Power.

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

König's Three-Colour Process.—This process, only recently published, has attracted a good deal of attention, and deservedly so, for it not only illustrates a new principle as applied to the purpose of colour photography, but has been worked out by its author to a successful issue. Whether or not it will be found to fulfil the conditions necessary to establish itself as a standard or commercial process, only time can prove. It is a triple film method, but differs from those previously proposed, in that each colour is printed out by light.

Many of the organic dye-stuffs yield on reduction colourless or leuco-derivatives, which can be oxidized to reproduce the original colour with more or less facility, and exposure to light generally facilitates this oxidation. By choosing a dye of a suitable colour, and one that yields a leuco-derivative of sufficient stability to withstand the necessary operations and yet is sensitive enough for practical printing purposes, it is obvious that the colour may be obtained directly by exposure to light under the negative, and the necessity for a relief produced by the chromated gelatine process, or any similar indirect method of getting the required distribution of the colour, is obviated.

These leuco-derivatives were found to be useless by themselves or in an inert film, as they then gave only poor and flat images, but the presence of a nitric acid ester was discovered to overcome this difficulty. Pyroxylin being an ester of nitric acid a collodion film is employed, and mannite nitrate is very suitable for further augmenting the sensitiveness. The removal of the excess of the leuco-derivative after exposure was at first a difficulty, as ordinary solvents and acids were found useless for the purpose. But monochloracetic acid is effective, and it is used as a ten per cent. solution.

The process consists in coating a suitably surfaced paper with a one-and-a-half per cent. collodion, to which the leuco-derivative and other desirable materials have been added, exposing under the appropriate negative until the colour is sufficiently intense, fixing in the chloracetic acid solution, washing, and dipping into a gelatine solution that contains chrome alum and drying. The print is again dipped into the gelatine solution and dried to effectively protect the collodion film during the application of the collodion that is to furnish the second colour. This routine is repeated for the second colour and again for the third, and the print is finally varnished.

The method of judging when each colour is correctly printed is not very clear, as it seems impossible to adjust the depth of tint of the films that are sealed up by the subsequent coatings. The process is apparently rather tedious, as there are three collodion films, six gelatine coatings, and a final coating of varnish to dry. The obvious objection to the number of films because of their combined thickness is probably invalid, as the collodion and the gelatine solution used are weak and the films they give correspondingly thin. A real difficulty I should have expected to be due to the action of the chloracetic acid on the gelatine films under the collodion film that is being subjected to the fixing

operation, but doubtless this possibility has received attention.

Lumière's Starch Method of Three-Colour Photography.—This process, which was described about six months ago, contrasts very emphatically with König's method in the simplicity of the necessary manipulation. No colour screens or filters are needed, there are no films to stain, no colours to produce of the correct intensity to match one another, no separate negatives with subsequent printings, but merely one exposure, ordinary development, and then, instead of fixing, the silver image is dissolved out and the remaining silver salt reduced to the metallic state. But if the work of the photographer himself is simple, it is because of the complex character of the prepared plate, and presumably it is the difficulties of manufacture that have led to the delay in putting the prepared plates on the market. The plates are made by selecting starch granules of from 15 to 20 thousandths of a millimetre in diameter, staining quantities of them red, green, and violet respectively, drying them, mixing them so that neither colour predominates but that the whole presents a neutral gray tint, and spreading the mixture on glass one layer thick. The interstices are filled in with a fine black powder, and the layer is fixed and protected by a coat of varnish. On this is put a film of suitably colour-sensitized emulsion. Exposure is given through the glass, and the subsequent treatment of the plate is as described above. The dyed starch granules form an irregularly grained three-colour screen, which serves the double purpose of taking and viewing.

It is easy to describe such a process, but besides the obvious mechanical difficulty of preparing the plates, there must be many compromises made before the result can be passably satisfactory. The best three colours for the exposure are not the best three for viewing the picture, but in this case they have to be the same. If the stained starch granules are mixed to the most neutral tint possible, it appears that a perfectly orthochromatised sensitive film would be necessary. The imperfections of the film in this matter must be neutralised as far as possible. Indeed, the difficulties of which the photographer is relieved have to be overcome by the manufacturer, and in this particular case they are so many and complex that if it had not been stated that results have been obtained in the manner described, we might very well doubt the possibility of it.

Lantern Demonstrations.—Optical lanterns are so often unskilfully used, even on occasions when the best methods of demonstration might well be expected, and sometimes when they are handsomely paid for, that I wish to take the present opportunity of calling attention to one matter now, and shall refer to other matters at a subsequent date. At scientific lectures it is often necessary to introduce a small piece of apparatus on to the stage of the lantern, such as an electroscope or thermometer, for example, in order that its changes during an experiment may be clearly seen by the audience. The lecturer must have ready access to the lantern to superintend or conduct the experiment. When there is no special provision for such demonstrations, the usual way is to fix up a sheet at the back of the platform, and to have the lantern at one side near the front of it. The lantern has to be tipped up to get the image above the level of the lecture table, its stage therefore, is sloping, and apparatus put on it is very likely to shift its position, if not to fall over; the lecturer when at the lantern is sure to be between the sheet and some of the audience, however he may contort his body to get it out of the way; and as the lantern is tipped up, and generally to one side of the sheet, the disc of light is far from circular, and it is impossible to focus more than a small part of the object, even when it is flat, at any one time. All these and other annoyances may be overcome by the use of a small translucent screen on the lecture-table with the lantern centrally placed behind it so as to give a two or three foot disc, taking care that the lantern is properly protected by screens to avoid the possibility of any light that may leak out from it glaring into the eyes of the audience. The lecturer would find this arrangement much more convenient, and the audience would see the projected image much more clearly, the fact that it would be smaller than otherwise usual being an unqualified advantage.

Phoebe, Saturn's Ninth Satellite.

By A. C. D. Crommelin.

There is no question that the discovery of Phoebe reflects the greatest credit on Prof. W. H. Pickering. It was no mere accident, but the result of a deliberate search for additional satellites which he has been carrying on for many years. Even after the existence of the satellite is known it is a tedious matter to identify it on a photograph, but to have discovered it in this way—one little grey dot among myriads of others—is, indeed, astonishing. Prof. Pickering explains the long delay in the confirmation of the original announcement by the fact that his attention was called off by his photographic work on the moon. In addition to this the unexpectedly large eccentricity of the orbit (0.22, four times that of our moon) made it much more difficult to detect Phoebe on the plates taken at Arequipa in 1900.

At length the idea occurred to him to extend the search to a greater distance from Saturn than he had hitherto thought sufficient, and there, in fact, Phoebe was found, near elongation, some 33′ from its primary, indicating a distance of nine millions of miles.

It was not till a few months ago that the most surprising feature of all—the retrograde motion round Saturn—was discovered.

It is well known that in double star orbits it is frequently impossible to say whether the upper or the lower half of the orbit is nearer to us; in the case of some bright stars, like Sirius or *a* Centauri, the spectroscope has settled the matter, but in other cases it remains insoluble. In the same way we could not tell from a single year's observations of Phoebe whether its motion was direct or retrograde, and it was even found possible to construct a direct orbit which would represent the observations of 1898 and 1900 without any large errors. But in 1904 the position of Saturn has changed so much that the direct and retrograde orbits are at once distinguishable, just as the question would be settled in the case of a double star if we could transport ourselves to a very distant standpoint, where we might view the system in another direction; and it is to be noted that the retrograde motion is indicated in two entirely different ways: (1), by comparing the position of the Perisaturnium, or nearest

point of the orbit to Saturn, in the different years; (2), by leaving the eccentricity out of account and simply considering the change of tilt of the apparent orbit, treated as a circle. Prof. Pickering deduced it by method (1), and I got the same result from method (2), being obliged to treat the orbit as circular since I had not enough material to determine the eccentricity.

The fact that (1) and (2) are in complete accord establishes the retrograde motion beyond reasonable doubt, and renders highly improbable the suggestion made by Mr. Monck and others that the satellite observed in 1904 is a different body from that observed in 1898 and 1900, both moving in direct orbits. For it would be a most astonishing coincidence that two independent satellites moving in direct orbits should be so related that a single retrograde orbit of large eccentricity should be capable of exactly simulating the movements of both.

The retrograde motion is still further confirmed by the fact that the observations indicate that the node of the orbit *advances* (about 3° per annum), since the node moves in the opposite direction to the revolving body.

The sidereal period of Phoebe is 547 days, or exactly 1½ years; the period from "New" to "New" is about 26 days shorter, or 521 days; this is also the average period between successive inferior conjunctions as seen from the earth. Thus is it alternately east and west of Saturn, for about 260 days in each position; while its maximum elongation considerably exceeds half a degree, as compared with 10′.4 for Japetus, 11′.3 for Jupiter's satellite IV., the two greatest elongations of satellites previously known. The mean distance of Phoebe from Saturn is exactly eight millions of miles, while the greatest and least distances are 9¾ and 6¼ millions. The inclination of its orbit to that of Saturn is about 5°.

Even as seen from Saturn, Phoebe would only appear like a tiny star of the fifth or sixth magnitude; so that it might remain undiscovered for ages by imaginary Saturnians, just as Uranus, although faintly visible to the naked eye, was not discovered till 1781.

Its diameter is estimated to be somewhere about 150 miles, slightly greater than that of Jupiter's satellite V. The two satellites, though similar in size, present a startling contrast in their motions; V. is remarkable for its proximity to Jupiter and its short period of 12 hours; also for the very rapid motion of the perijove, which makes two entire revolutions in a year; this arises from the action of Jupiter's equatorial protuberance. In Phoebe's case the perturbations produced by Saturn's oblateness and by the other satellites must be insignificant. The solar perturbations, however, assume an importance which they do not possess in the case of any other satellite except our moon. Prof. Newcomb estimates that the coefficient of the evection is about 4°, three times the amount for our moon; this will shift Phoebe some 2½ as seen from the earth, and will, therefore, be a readily measurable quantity. The apse moves round Saturn about ¾° annually in the same direction as Phoebe. It is thought that the effect of Jupiter's action on Phoebe's motion will also be appreciable; there is a good deal of matter here awaiting mathematical treatment, and it is not impossible that some further light may incidentally be thrown on the theory of our own moon.

Prof. Pickering gives some speculations *re* the bearing of Phoebe's retrograde motion on the nebular hypothesis. He supposes the planets to have once formed rings of matter revolving round the sun; then since the inner portion of the ring would revolve the quickest, when the ring coalesced into a planet the part next the sun would be moving quickest, *i.e.*, the planet would be rotating in a retrograde direction. Thus he supposes that all the planets originally had retrograde rotations, and next asserts that this state of things was unstable owing to the action of solar tides, which tended to turn the planet over so as to make the direction of rotation the same as that of revolution. This point will need careful examination by our leading mathematicians, but if we assume it provisionally it will explain a good many things about the solar system. Phoebe is supposed to have been born in very remote ages, when Saturn rotated backwards; while Saturn was turned over before the birth of Japetus and the inner satellites. It also appears that distant satellites, like our moon, Phoebe, and Japetus, are compelled by the sun to move in planes near the primary's orbit; while near* satellites, such as those of Mars, Jupiter, Saturn (7 inner), and Uranus (presumably) are in the equatorial plane of their primary.

The theory explains the retrograde motion of the Uranian and Neptunian systems by supposing that the solar tides have been too weak at such great distances to turn the planets over, though Uranus would seem to have been turned about half way, and Neptune one-quarter of the way. Thus the new theory tends to bring these outer planets into line with the others, and to remove a difficulty which had always been felt with regard to the application of the nebular hypothesis to them. Going to the other extreme, the slow rotations of Mercury and Venus, which are now accepted by many astronomers, would likewise find an explanation in solar tides, so that these would seem to have left their traces on the system from one end to the other. They were doubtless much more powerful in distant ages, when the planets were larger and more diffused than they are at the present day.

* The word "near" is to be understood relatively to the size of the primary, compared with which Jupiter's satellites are all much nearer to him than our moon to the earth.

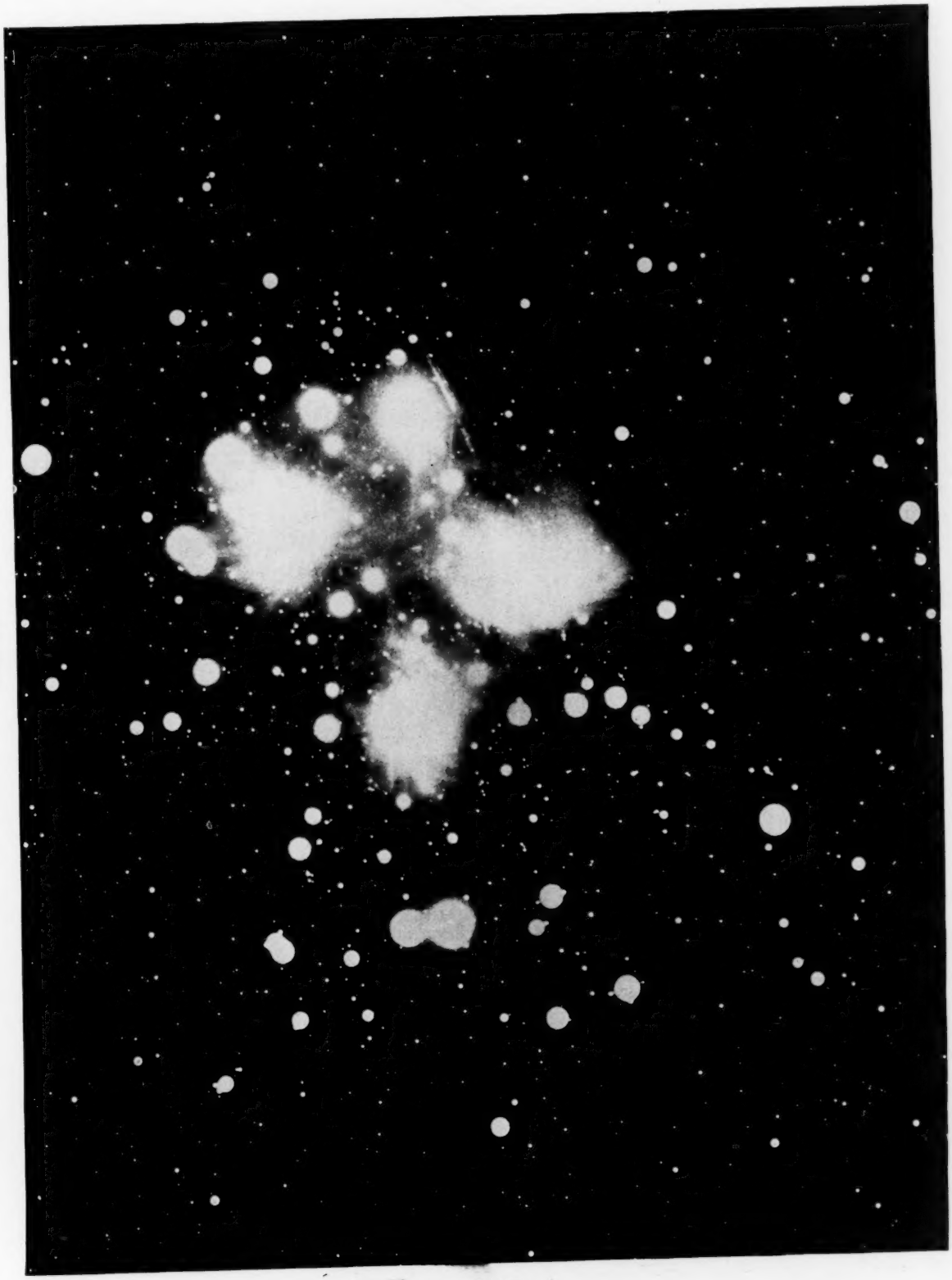
The Inner Nebulae of the Pleiades.

By Dr. Max Wolf, F.R.A.S.

The original plate of the accompanying photograph was taken by the writer with the "A" lens of the 16-inch Brashear twin telescope, on December 22, 1902, with five hours' exposure. The plate was carefully backed with a black coating, so that the well-known halation circles do not appear round the bright stars. The accompanying photograph has been enlarged three times from the original negative. In order to bring out the inner nebulæ it was necessary to greatly prolong the process of copying, so that the fainter outer nebulæ have become over-darkened. The extremely curious straight lines of nebulous stream are very well seen. The inclined and partly doubled stream near Electra* is a defect and not a true nebula. We see that all the brighter stars of the Pleiades are systematically connected by streams of nebulous matter beautifully fine in structure.

*Electra is the nebulous star 2·8 inches from the west side of the plate, and 3·7 inches from the south side.

WEST.



NORTH.

SOUTH.

EAST.

The Inner Nebulæ of the Pleiades.

From a Photograph by DR. MAX WOLF.

XUM

Sunspot Variation in Latitude.

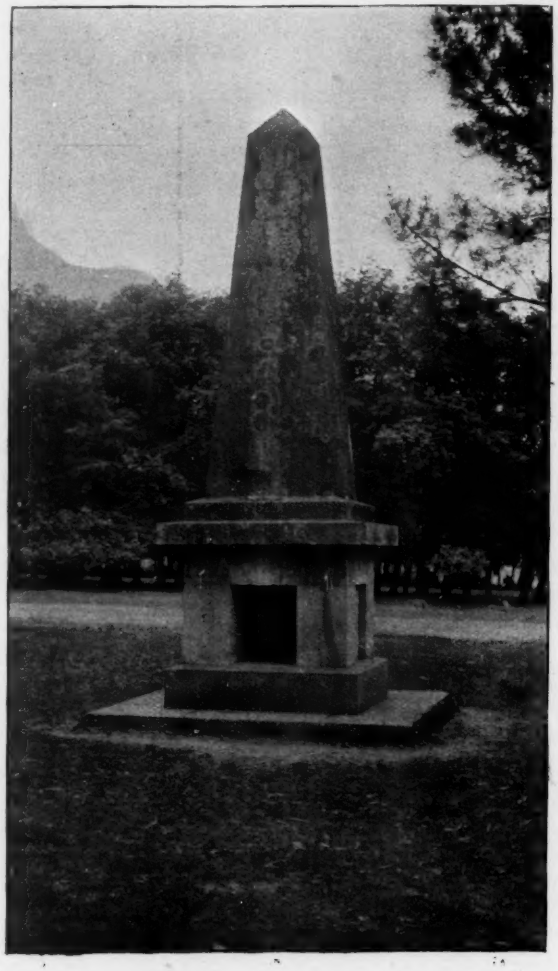
By E. Walter Maunder, F.R.A.S.

Dr. Lockyer's object in his two letters would appear to be twofold. First, to indicate his dislike of a short note on page 159 of the July number; second, to make a certain claim for himself. Under the first head he has failed to point out a single inaccuracy in the note, though his two letters together exceed it in length more than ten times. I think the note stands vindicated as having presented in nineteen lines the gist of three long papers with truth and remarkable conciseness. Under the second head, Dr. Lockyer introduces much wholly irrelevant matter, but avoids the only two questions which really bear on the point of his claim. Did he make use of a certain paper, and if so, did that paper already contain the result which he claims as his own, definitely and explicitly set forth? Dr. Lockyer does not and cannot deny that he did use the paper in question, and that it did so contain that very result. Whether that result confirms or contradicts Spoerer's Law, is a matter which has no possible bearing on Dr. Lockyer's claim to it. Nor is it, in this connection, of the smallest significance by whom or under what conditions the paper was written, which Dr. Lockyer used, and wherein he found the result in question.

The Herschel Obelisk near Cape Town.

We are indebted for the accompanying photograph to the courtesy of Mr. W. H. Wesley, to whom it was sent by Mr. Clement Jennings-Taylor, from whose covering letter to Mr. Wesley, we are permitted to make the following extracts:—

It may interest you to know that my house is close to where Herschel's old residence stood; his monument standing about 100 yards in front. I am sending you a good amateur photograph of the obelisk taken by a friend, Mr. S. Rutherford, as I thought you might like to reproduce it. The obelisk, which by the way forms the crest of the Claremont Municipality, is very plain, and covers a small round pedestal of granite. This pedestal can be dimly seen in the photograph, together with the "H" forming part of the four initials cut deep into and round the same. On the top the date is deeply cut, "1838," to see which one has to crawl into the hole. A brass tablet is shortly to be fixed on one side, and I understand that the Council is willing to find half the cost of railing the monument round, provided the remainder can be raised by subscription—some £100 to £150 *in all*. It has been neglected of late years, and seeing that the obelisk, with some 50 or 60 feet of ground round it, is public property, it seems a pity some protection is not arranged for. The ground about is at present open, except for the schools just in front, but as the estate has been cut up and mostly sold in lots, it will soon be built over, and then will come the danger of damage. The monument is placed astronomically true N. and S., the front or opening being due south. A pretty view of the Devil's Peak is seen above, to the left, and the oak trees make an excellent background. The weather marks on the stone are also wonderfully reproduced. Strange to say, a great many people residing in the district and in Cape Town do not know of the existence of the obelisk, and a greater number probably do not know who Herschel was or what he did, so the lack of interest in and care of the memorial stone may be somewhat accounted for. I was showing it to an acquaintance one



day, when he surprised me with "Oh, Herschel! that's the chap who invented the steam engine, isn't it?" Half an hour in my little observatory opposite enlightened him on the subject, though he confessed that "he didn't think it much of a money-making business."

Ancient Egypt.—The "Short History of Ancient Egypt" (Constable) which has been compiled by Percy E. Newberry and John Garstang is almost as concentrated as Bovril is said to be by its advertisers. But whereas Bovril contains 90 per cent. of water, there is positively no dilution of any sort or description in this most useful little work. Mr. John Garstang is known to readers of "Knowledge" by the Beni Hasan excavations, some account of which appeared in the August number; and his name, like that of Mr. Newberry, is a guarantee of thoroughness. Into the volume's hundred odd pages are packed the important events of three thousand years of Egypt's rise and fall. It aims at a scientific statement of proven facts, and it ignores theories and traditions. It will have a few enemies among the theorists, but it will make more friends—for itself and for historic Egypt.

NOTES.

ASTRONOMICAL.

Herr Nippoldt on the Connection between Solar Activity and Terrestrial Magnetism.

In the October number of the *Astrophysical Journal*, Herr A. Nippoldt, of the Potsdam Magnetic Observatory, criticised a recent paper by Father Cortie on "The Solar Prominences and Terrestrial Magnetism." The latter had endeavoured to show that the eclipse spot group of 1901, if it may so be called, by far the largest spot group of the year, had no effect upon terrestrial magnetism. Herr Nippoldt claims that a small but evident disturbance did take place during the passage of the spot. He is also emphatic that we have no right to assume that no disturbance has taken place unless magnetic stations near the pole have exhibited no deviations from their normal curve. He insists that there should be no kind of statistical definition of the idea of disturbance, that the maximum amplitude can hardly be usable to decide whether or not a curve is disturbed, and that we may represent the nature of the effect of the solar action upon terrestrial magnetism as a sort of relay action—"the strength of the releasing solar activity need not have a definite relation to the strength of the magnetic storm." He therefore desires to substitute for the statistical method the investigation in detail, and calls for a continued and uninterrupted registration of the changes occurring on the sun.

The paper is most disappointingly vague and inconclusive. The small disturbance of which he gives a trace can hardly be said to have been "simultaneous" with the spot, except in a very loose sense of the term, whilst it is only by a searching application of the statistical method that we can hope to discriminate between synchronisms which are purely accidental, and those which may be legitimately taken as establishing connection.

* * *

Demonstration of the Solar Origin of Magnetic Disturbances.

Quite a different method of treating this question was adopted by Mr. E. W. Maunder in a paper read before the Royal Astronomical Society on November 11. Tabulating all the magnetic disturbances of 20′ in declination and over, recorded at Greenwich Observatory from 1882-1903, and computing the heliographic longitude of the centre of the sun's disc for the time of commencement of each disturbance, it became clear at once that many of these disturbances recurred when the same solar meridian returned to the centre of the disc. In fact more than three-fourths of the total number catalogued (276) were included in some one of these series. There is only one conclusion, it was urged by Mr. Maunder, to be drawn from this relation, namely that the exciting cause of our magnetic disturbances was associated with definite limited areas on the sun. Further the magnetic action, whatever its nature, did not radiate equally in all directions, like light and heat, but acted along very definite and restricted lines. The mean rotation period indicated for these areas was the same as that given in the mean by the sunspots; the extreme periods were those given by what we may fairly call the extreme sunspots, that is to say those on the equator and in latitude 30°. Mr. Maunder found an analogy to these magnetic stream lines in the long rays of the corona, as photographed in the 1898 total solar eclipse. The solar action being of this nature, it is perfectly clear that the stream lines from many spots may miss our earth altogether, and hence a great spot need not necessarily be accompanied by a magnetic storm. On the other hand some of the disturbances recurred rotation after rotation when the spots with which they synchronised at their commencement had ceased to be visible. The paper therefore not only establishes an entirely new conception of the solar action in producing our magnetic disturbances, but suggests that there are definite active areas on the sun, intermittent in their activity, of which activity spot formation is an important phase.

* * *

The Spectra of R Scuti and W Cygni.

Mr. Ralph H. Curtiss has succeeded in photographing the spectra of both of these stars, and found the hydrogen lines bright at maximum. *R* Scuti gave a spectrum resembling the solar type; *W* Cygni a banded spectrum, with the bands sharp towards the violet and shaded off towards the red.

* * *

Rotation Periods of Venus and Mars.

In the "Comptes Rendus" of the Paris Academy, Mr. Lowell gives the result of a series of spectrographic determinations of the rotation of these two planets. For Venus, the speed of motion of a point on the equator was found to be practically nil, the probable error of the observation only amounting to 0·008 kilometres per second, the result thus supporting the idea that Venus rotates in the same period as her revolution. For Mars the speed was found as 0·228, the computed value being 0·241. The probable error in the case of Mars was 0·036. The satisfactory result obtained for Mars lends support to that for the larger and brighter planet.

We deeply regret to record the death of Mr. Frank McClean, M.A., LL.D., F.R.S., M.Inst.C.E. Mr. McClean was distinguished for his important spectroscopic researches and his liberal donations to further the cause of astronomy. His spectroscopic work included an elaborate series of comparative photographs of the high and low sun, a fine atlas in which he studied the comparative photographic spectra of the sun and the metals, and a great spectroscopic survey of all the brighter stars in the heavens. In order to render this work complete, Mr. McClean visited the Cape Observatory in 1897, where for six months he carried on his survey of the southern heavens. In the course of this work, he was able to identify between 40 and 50 of the lines of oxygen in the spectrum of Beta Crucis. His benefactions to astronomy include his foundation of the Isaac Newton Studentships at Cambridge, and the magnificent photographic telescope with its fine spectroscopic equipment which he presented to the Cape Observatory. Mr. McClean died at Brussels on the morning of November 8 in his sixty-seventh year.

We heartily congratulate the Astronomer Royal, Sir W. H. M. Christie, F.R.S., on his promotion to the rank of Knight Commander of the Order of the Bath (K.C.B. Civil Division).

* * *

Encke's Comet.

Encke's Comet has been not only photographed, but has also been seen and observed by Professor M. Wolf at the Astrophysical Observatory, Königstuhl, Heidelberg, on October 29. It has also been observed by Professor E. Millisevich, at the Observatory of the Roman College, in Rome, on October 30, and by Professor E. Hartwig, at the Bamberg Observatory, on October 31. The Comet is much fainter than was anticipated, and it is feared will never be bright enough to be seen with the naked eye.

* * *

The Parallax of Alpha Centauri.

At the station in the southern hemisphere of the Lick Observatory, located at Santiago de Chile, observations have been made during the past year of Alpha Centauri, and an average difference between the radial velocities of the two components is found of about 5·17 km. This may perhaps be due to the relative orbital motion of the two components, and, if so, it would indicate a parallax of 0·76, a combined mass of the components of 1·9 that of the sun; and a mean distance between the two components of $3{\cdot}46 \times 10^9$ km. The parallax thus indicated is almost precisely that resulting from heliometer observations.

XUM

Intermittent Disturbances on Jupiter.

In the *Observatory* for October, Mr. Denny arrives at the very significant conclusion that "features exhibiting various peculiarities of appearance and rates of motion are common to certain latitudes and break out from time to time, enduring for certain unknown intervals, then disappearing to be replaced by similar phenomena." In his recent paper to the Royal Astronomical Society, Mr. Maunder draws attention to a somewhat similar intermittent action in the magnetic disturbances observed on the earth which are associated with certain solar longitudes.

BOTANICAL.

By S. A. Skan.

The exhibition of an extraordinary grass fruit at a meeting of the Linnean Society was noted in the columns of "Knowledge" nearly three years ago. A full account of its remarkable structure, written by Dr. Otto Stapf, is now published in the last part of the Society's Transactions. The fruit is the product of *Melocanna bambusoides*, which belongs to the tribe Bambuseæ of the grass family. It is an arborescent plant, growing to a height of from fifty to seventy feet, and is a native of Eastern Bengal and Burma. Unlike the ordinary fruit of the Gramineæ, which is small, often almost minute, and albuminous, that of *Melocanna* is sometimes as much as five inches long and two inches thick, globose or ovoid in shape, and exalbuminous. It is also remarkable in being viviparous, germinating before it falls from the parent plant, but this does not appear to be a constant character. Its pericarp, instead of the thin, membranous or crustaceous body of the usual grass fruit, serving practically only a mechanical function, is very largely developed and is fleshy, and serves partly as a reservoir for food material, a function which is shared by the scutellum, though this body retains its original character as a haustorium. Some albumen, or more correctly, endosperm, is formed in *Melocanna*, but Dr. Stapf shows that at an early stage it collapses "and is finally crushed into an apparently structureless film, wedged in between pericarp and scutellum."

* * *

The latest part of the "Annals of the Royal Botanic Garden, Calcutta," contains an elaborate monograph of the species of *Dalbergia* of South Eastern Asia, by Major D. Prain. *Dalbergia* is a large genus of Leguminosæ (Papilionaceæ), chiefly inhabiting the warmer parts of Asia. Its species are trees or climbing shrubs insignificant in their flowers, but several are important economically on account of their wood. *Dalbergia latifolia* is the Indian Blackwood or Rosewood, valuable for furniture. The Sissoo (*D. Sissoo*) supplies a timber remarkable for its strength and elasticity. Like the excellent monographs of *Quercus*, *Ficus*, and other genera which have appeared in the "Annals," Major Prain's work is accompanied by numerous illustrations.

* * *

Wiesner, Bonnier, Warming, Schimper, and other botanists have published observations on the influence of either humidity, heat, or light on plant structures. Monsieur J. Bédélian, in a series of papers appearing in the current volume of the *Revue Générale de Botanique*, shows the combined influence of these agencies on the growth in a greenhouse of several common plants which are found growing wild in the neighbourhood of Paris. Specimens of such plants as the Daisy, Dandelion, Shepherd's Purse, Plantain (three species), and Milfoil were selected, some of each species being grown in the open air and others in a greenhouse. The experiments were carried on between the months of November and May. During this period, especially, the conditions of heat, light, and moisture in the greenhouse would be very different from those prevailing outside. The heat would be greater and more equable, the light more diffused, and there would be more moisture in the atmosphere. The influence of cultivation in the greenhouse on plants which normally produce a rosette of leaves adpressed to the soil was shown in a pronounced elongation of the internodes whereby the rosette arrangement disappeared, the leaves tended to become erect, and a marked increase in size was noticed. The internal structure of the roots, stems, and leaves of each set of specimens has been carefully examined and compared. In general the plants grown in the greenhouse have less differentiated tissues, less wood is formed, cell-walls are thinner, and intercellular spaces larger.

ORNITHOLOGICAL.

By W. P. Pycraft.

A Nestling Touracou.

At the last meeting of the British Ornithologists' Club, Mr. D. Seth-Smith exhibited the only known nestling of a Touracou. This was of the species known as Fraser's Touracou (*Turacus macrorhynchus*). The unique character of this exhibit was still further increased by the fact that the bird had been hatched in confinement in the aviaries of Mrs. Johnstone, at Bury St. Edmunds.

Mrs. Johnstone is the possessor of a pair of these birds, which, after a preliminary but abortive attempt at nesting in June last, succeeded, towards the end of July, in hatching two eggs, laid in a nest of sticks placed on a hamper-lid in a rhododendron bush.

Only one egg seems to have hatched out, and the nestling therefrom lived for four weeks, when it was killed by the cold nights of September.

Hitherto nothing was known of the condition of the young Touracou at birth. It was supposed that it would prove to resemble the young of the cuckoo; but this is not the case, inasmuch as the young cuckoo remains quite naked till the feathers appear, while the young Touracou is sparsely clad with down feathers, and bears a rather close resemblance to the remarkable and aberrant Hoatzin.

The wings of this nestling were, at the time of death, of great size, while the rest of the body remained still invested in its downy coat. Save that it was seen to clamber about the nest occasionally during the day, nothing was learned concerning it during life; but it is probable that the habits of the nestlings will turn out to resemble those of the Hoatzin described in our last issue.

* * *

Short-Eared Owl Nesting in Hampshire.

Mr. Trevor-Battye, in the *Avicultural Magazine* for November, records the breeding of a pair of Short-Eared Owls (*Asio accipitrinus*) on Bransbury Common, where a pair of young birds were successfully reared. This appears to be the first known instance of the nesting of these birds in this country.

* * *

Robins Catching Fish.

The *Field*, October 15, contains an interesting account of a party of five robins which were discovered hunting about among the pebbles in the bed of a small stream, from which they constantly flew on to a neighbouring wall, carrying some live object in their beaks. On a visit to the spot being made, a stickleback kicking vigorously was found. The observer (who signs himself "W. H.") then retired for about ten yards and watched their proceedings. The fish was taken from the water crosswise, and borne from the water to the wall to be dispatched. There seems to have been no attempt made to kill the prey before eating, as is done by the kingfisher; but then the fish was not swallowed alive.

* * *

A White Snipe.

A very beautiful white variety of the Common Snipe (*Gallinago cælestis*) has just been received at the Natural History Museum, South Kensington. This bird was killed at Poltallock, Argyllshire. The only normally-coloured feathers were a patch on each side of the head, meeting one another at the crown; a few scapulars, the tail and under tail-coverts, a few under wing coverts, and three primaries in the left wing.

Sheep's Wool and Birds' Legs.

At the first meeting of the winter session of the Ornithologists' Club, Mr. Ticehurst exhibited a series of legs of the lapwing taken from birds shot on Romney Marsh during August last. These were very remarkable, inasmuch as they showed various stages of necrosis of the lower part of the leg, caused by the sheep's wool having become wound round the part affected.

In one of these legs the wool had been successfully removed by the bird and only a scar was left. In another the wool had so tightly encircled the toes that a partial necrosis of one member had taken place. In a fourth specimen this ligament had wound itself around tarso-metatarsus just above the toes, and in consequence these had all been lost.

A yellow wagtail with feet similarly affected was also shown. It is worthy of note that we have no records of starlings being affected in this way.

* * *

Spotted Crake in Antrim.

A Spotted Crake, records the *Field*, October 22, was shot near Templepatrick, Co. Antrim, on October 8. This makes the sixth occurrence of this bird in Antrim.

* * *

Solitary Sandpiper at Rye.

Mr. C. B. Ticehurst exhibited at the October meeting of the Ornithologists' Club a Solitary Sandpiper (*Totanus solitarius*) shot at Rye Harbour, Sussex, on August 7. This is the fourth British example of this American species.

* * *

Tawny Pipit at Rye.

At the meeting of the Ornithologists' Club just referred to Mr. C. B. Nicoll reported that three specimens of the Tawny Pipit (*Anthus campestris*) had been taken at Rye Harbour during August last. He himself shot an immature bird of this species on the sea-banks of Sussex near Bexhill. From the numerous occurrences of these birds he expressed his opinion that the Tawny Pipit was a regular autumn visitor on migration.

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Lapland Bunting near Pevensey.

Mr. C. B. Nicoll also reported that he had procured an immature example of the Lapland Bunting (*Calcarius lapponicus*) near Pevensey on September 28.

* * *

Broad-Billed Sandpiper at Rye.

Now that closer attention is being paid to birds on migration in the neighbourhood of Rye a number of rarities are being discovered. Mr. Nicoll, in addition to the records just described, also reported the occurrence of an immature Broad-Billed Sandpiper (*Limicola platyrhyncha*), which had been shot at Rye, Sussex. This is the fifth record of the occurrence of this bird in Sussex.

ZOOLOGICAL.

By R. Lydekker.

Quaggas and Wild Asses.

The present year has been noteworthy from the amount of literature devoted to the members of the horse tribe, or *Equidæ*. One of the latest contributions to the subject is an article by Mr. R. T. Pocock, the Superintendent of the London Zoological Gardens, on South African quaggas, published in the November number of the *Annals and Magazine of Natural History*. According to the author, we have to deplore the extermination not of one, but of several distinct forms of these animals; the quaggas of the older writers, of which two races are recognized, being distinct from those exhibited forty years ago in the Regent's Park and other menageries. Without for a moment saying that the author may not be right in his view, it certainly does seem strange that the whole of the quagga-skins which have come down to us should differ from the animals described by the older zoologists. The Asiatic and African wild asses form the subject of a paper by the present writer published in a recent issue of *Novitates Zoologicæ*, the organ of Mr. Walter Rothschild's zoological museum at Tring; an apparently new race of the "onager" from Central Asia, now living in the Duke of Bedford's park at Woburn, being described and figured. The description of one of the two races of the African wild ass is based on specimens killed in the Eastern Sudan by Mr. N. C. Rothschild, one of which is now mounted in the British (Natural History) Museum, while there is a second in the Edinburgh Museum, and a third in Mr. Rothschild's own collection. As the construction of the Suakin-Berber railway is only too likely to lead to the extermination of this race, these specimens are very precious.

* * *

The Ancestry of the Horse.

In connection with articles on this subject, which have appeared during the year in "Knowledge" our readers may be referred to one by Professor H. F. Osborn on the evolution of the horse in America, published in the November number of the *Century Magazine*. The author is of opinion that the modern type of horse (that is to say, the genus *Equus*) was evolved in North America, whence it migrated by way of Bering Strait into Asia, and so into Europe and Africa. He is also inclined to look favourably on the theory that the blood-horse has a different ancestry to the ordinary breeds of Europe.

* * *

A White Racoon-Dog.

For many years naturalists have been familiar with a remarkable Japanese and Chinese animal which, although externally somewhat like an American racoon, yet is really an aberrant member of the dog-tribe. Those who attach importance to external characters, rank the creature as the representative of a genus by itself, under the names of *Nyctereutes procyonoides*; while those who consider that generic distinctions should rest on important structural differences class it with the more typical dogs, as *Canis procyonoides*. The New York Zoological Park possesses at the present time a pure white racoon-dog, stated to have been brought from Northern Japan, which is regarded as representing a second species, for which the name *Nyctereutes albus* has been proposed.

* * *

A New Snake-Salamander.

The description (in the *Annals and Magazine of Natural History* for October) of a new species of those strange worm-like burrowing amphibians generally known as cœcilians, but which may be better designated in popular zoology as snake-salamanders, would scarcely seem at first a subject for notice in this column; but, as a matter of fact, this particular case has a very wide and important interest. The species in question, which comes from the Kachar district of Assam, is described by Major Alcock under the name of *Herpele fulleri*; and it is in regard to the peculiar geographical distribution of the genus that the interest of the new discovery lies. With the addition of the new species, the genus *Herpele* is represented in India, Panama, and West Africa; and, as Major Alcock remarks, such a distribution, in the case of a worm-like burrowing group appears altogether inexplicable on the theory that continents and ocean-basins are permanent, or, indeed, anything like permanent. On the other hand, the distribution of *Herpele*, together with that of certain sub-littoral hermit-crabs, which is curiously similar, affords strong support to the now generally accepted view that India and Africa were connected by land at a comparatively recent epoch of the earth's history (that is to say, within the lifetime of an existing highly specialised genus). The two instances also add one more link to the chain of zoological evidence which apparently points to a former land connection between Africa and South America across the Atlantic. The Indo-African connection, which is supported by geological as well as by zoological evidence, would explain the presence of cœcilians in the Seychelles as well as the absence of the above-mentioned littoral hermit-crabs from the east coast of Africa. The alternative view to the trans-Atlantic connection between West Africa and America (apart from one by way of the Pacific)

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would be that these snake-salamanders travelled from a common northern home down the Eastern and Western Hemispheres, but this seems almost incredible.

* * *

The Animals of Africa.

The recent discoveries of wonderful new types of extinct animals in the tertiary deposits of the Fayum Desert of North-Eastern Africa, and their bearing on the origin of the modern African fauna, are discussed by the present writer in the October number of the *Quarterly Review*, in an article with the above heading. The new evidence shows unmistakably that the Proboscidea (elephants and mastodons) and the Hyracoidea (the "coney" of Scripture and its relatives) were developed in Africa itself; but it does not appear to invalidate the long accepted theory that the bulk of the modern African fauna is of northern origin. It might, however, have been added that, in view of the discovery of certain antelope and other remains in the later tertiaries of Africa, the migration may have been somewhat earlier than commonly believed. Probably, indeed, there have been several migrations of African types to the north, and of European and Asiatic types into Africa,

In this connection it may be mentioned that Dr. C. W. Andrews, the chief describer of the extinct Fayum fauna, has brought to notice in the November number of the *Geological Magazine* a remarkably fine shell of the giant land-tortoise, *Testudo ammon*, of the Upper Eocene beds of the district in question. This appears to be the earliest of the big land-tortoises, and may have been the ancestral type from which those of Madagascar, Mauritius, and the Mascarene Islands, together with the extinct Indian species, were derived.

* * *

An Intelligent Chimpanzee.

Berlin possesses a successor to the late lamented chimpanzee "Consul" in the shape of Consul II., of which the following account has been published. Recently Consul II. appeared before a meeting of the German Psychological Society, and was the subject of a lecture by the eminent psychologist, Professor Hirschlaff. The ape stood on the platform beside the lecturer in a smoking jacket, top-hat, black trousers, boots, and shirt. Professor Hirschlaff gave Consul an excellent character. He has good manners, is of a friendly disposition, and manifests symptoms of what would be called in human beings a loving nature. He has no objection to the vicinity of dogs, cats, or snakes, but is afraid of horses. No traces are seen in Consul of any special liking for women and soldiers. Like most apes he delights in children, but evinces an abhorrence of dolls, of which he can make nothing, and retires vanquished from their presence. If Consul is tickled he sometimes shrieks with laughter. When punished he acts like a child, holding his hands before his face. If discovered at anything he is forbidden to do he assumes hypocritically an innocent demeanour, which is distinctly human. He is restless, and cannot sit long in one position. With an excellent memory, he is yet incapable of expressing his wants either by gestures or sounds. He cannot be taught to whistle, nor does he understand human speech. All he can comprehend is the tone of a voice or the rhythm of words; and he cannot be taught to reckon. Although Professor Hirschlaff said that the psychological abilities of Consul are separated from those of human beings by a wide gulf, it is interesting to note how many complicated actions he can comprehend with the intellectual powers he possesses.

* * *

Papers read.

At the first meeting for the session 1904-5 of the Geological Society, held on November 9, the Rev. Osmund Fisher read a paper on the remains of the extinct southern elephant (*Elephas Meridionalis*) found in a cleft in the chalk at Dewlish, Dorsetshire. It was suggested that the cleft was the work of man, and was made for the purpose of entrapping the elephants, which fell into it. At the first meeting of the Linnean Society, held on November 3, Professor Herdman described certain features in the gills of the Ceylon pearl-oyster. Mr. A. W. Waters described some Bryozoa from Cape Colony, several of which he regarded as indicating new species. At the meeting of the Royal Microscopical Society on October 19, Mr. W. Colver directed attention to a peculiar laminated structure at the tip of the antenna of the common flea, which it was suggested might be an organ of smell. The following papers were read at the meeting of the Zoological Society on November 15:—On Mammals from Fernando Po, and on *Hylochoerus*, the Forest-Pig of Central Africa, by Mr. O. Thomas; on the Species of Crowned Cranes, by Dr. P. C. Mitchell; and on the Mouse-Hares of the genus *Ochotona*, by Mr. J. L. Bonhote. The alleged occurrence of Père David's deer (*Elaphurus davidianus*) in the island of Hainan was discussed at the same meeting by Mr. Lydekker; and various specimens were exhibited.

* * *

A New Wild Sheep.

Sportsmen will be interested in the description by Dr. J. A. Allen of an apparently new species of wild sheep from North-Western Kamchatka, belonging to the Algali group, as typified by the magnificent *Ovis ammon* of the Altai. The only wild sheep previously known from Kamchatka was *O. canadensis nivicola*, a near relative of the northern races of the American bighorn. Dr. Allen, whose article appears in the *Bulletin* of the U.S. National Museum, proposes to call the new sheep *O. storcki*, in honour of the collector of the type skull.

* * *

The Nature of Grouse Disease.

Among some of those qualified to form a trustworthy opinion the view seems to be gradually gaining ground that grouse disease is due to the presence of parasites (Sporatozoa) in the blood, and that, as in the case of malaria, the germs of these parasites are introduced into the blood by the bites of insects, the carriers in this instance being apparently midges, which at certain seasons absolutely swarm on the moors. On the other hand, in a fashionable weekly contemporary, a sportsman expresses his dissent from the view that the infection is carried by means of the midge. He may be pardoned for urging that the disease sometimes makes its appearance at seasons when midges are scarce; but when he proceeds to state that "if the midge by biting the grouse, a thing which has yet to be proved, infects him with virus so deadly, it is strange that men and deer, whom he certainly does bite, suffer nothing more than temporary irritation," he displays ignorance of some of the first principles of the subject. It may be added that there are still people who refuse to believe that malaria is propagated by means of mosquitoes.

* * *

Two More Extinct Animals.

A writer in the *Field* points out that two animals have comparatively recently become extinct without attracting notice on the part of naturalists. The one is the great straight-horned race of the Indian buffalo (*Bos bubalis macrocerus*), which used to be met with, although rarely, in the Assam jungles as late as the "forties." The second is the wolf of the Falkland Islands (*Canis antarcticus*), an interesting but perhaps introduced species which appears to have been exterminated by strychnine during the "seventies."

* * *

Jerboas and Birds.

A curious structural resemblance has recently been pointed out as existing between the skeleton of the hind-leg of that pretty little Egyptian hopping rodent the jerboa and the same part in birds. In both the mammal and the bird the lower part of the leg is formed by a long, slender cannon-bone, or metatarsus, terminating inferiorly in triple condyles for the three long and sharply-clawed toes, the resemblance being increased by the fact that in both cases the small bone of the leg (fibula) is fused with the large one (tibia). It is further pointed out that in mammals and birds which hop on two legs, such as jerboas, kangaroos, thrushes and finches, the proportionate length of the thigh-bone or femur to the tibia and foot (metatarsus and toes) is constant, being 2 to 5; in animals, on the other hand, such as hares, horses, and frogs, which use all four feet the corresponding lengths are 4 to 7. It will, of course, be obvious that the resemblance between the jerboa's and the bird's skeleton is entirely owing to adaptation to a similar mode of existence. An interesting point in connection with the jerboa is that in the young the proportion of the femur to the rest of the leg is the same as in ordinary running animals.

Further, at an early stage of development the fibula is a complete and separate bone, while the three metatarsals which subsequently fuse together to form the cannon-bone are likewise separate.

* * *

Were Our Ancestors Negroes?

An extremely interesting point with regard to the ancestry of the European or Caucasian races of mankind has been recently raised by certain discoveries on the Continent. It appears that the Anthropological Society of Paris has recently received two ancient skulls, the one from the dolmen of Pointe-de-Conquet, and the other from a tumulus in Brittany, both of which are distinctly of the negro type. Again, two other skulls of a similar type have been discovered in the cave of Baoussé-Roussé, near Mentone; while two more are recorded from the valley of the Rhone, in Valais, which belong to a more modern age. All these exhibit the characteristic negro feature of projecting jaws (prognathism), although it is not stated whether this is accompanied by the large teeth distinctive of modern negroes.

This indicates that the prognathic type of skull made its appearance occasionally among our prehistoric ancestors, as it does indeed now and then among ourselves; whether, however, this is due to direct inheritance, or whether it is sporadic, there is no evidence to show. Neither can we pronounce with any degree of certainty whether our earliest ancestors were or were not negroes.

Royal Society.

Award of Medals.

SUBJOINED is a list of this year's recipients of the medals in the gift of the Royal Society, the presentation of which took place at the anniversary meeting on St. Andrew's Day, November 30:—The Copley gold medal to Sir William Crookes for his experimental researches in chemistry and physics; the Rumford gold medal to Prof. Ernest Rutherford for his investigations into the properties of radio-active matter; Royal gold medals to Prof. William Burnside and Col. David Bruce, respectively, for mathematical researches and for researches into the causation of various tropical and other diseases; the "Sir Humphry Davy" gold medal to Prof. W. H. Perkin, jun., for his work in synthetic organic chemistry; the Darwin silver medal to Mr. William Bateson for investigations in heredity and variation; the "David Henry Hughes" gold medal to Sir Joseph Wilson Swan for his practical applications of electricity; the Sylvester bronze medal to Prof. Georg Cantor, of Halle, for researches in pure mathematics.

Copley.—The name of Sir William Crookes is one of the most familiar amongst English scientific men; instinctively we associate him with the most fruitful chapters in the record of physical science of the past half-century. In his hands spectrum analysis has yielded a rich harvest of results. Long ago, by its aid, he discovered the element thallium. Electrical science has been consistently advanced through his deductions and experimental skill, exemplified by a series of investigations, all the more sure because never hurried. Following the recognition of radium by the Curies, he became an ardent student of the problems surrounding its behaviour and properties. In this connection his researches (with Sir James Dewar) on the effect of extreme cold on the emanations of radium may be instanced. Mention, too, should be made of the invention of the ingenious Spinthariscope, which demonstrates to the eye those scintillations proceeding from radium nitrate which, in his own apt words, convey the appearance of a "turbulent luminous sea." Sir W. Crookes' medallic roll of honour comprises, in addition to the present award, the Royal medal (1875), and the Davy medal (1888).

Rumford.—Prof. Ernest Rutherford, whom, by the way, the Cambridge School of Physicists include in their ranks, since he was a pupil of Prof. J. J. Thomson, is one of the younger workers in the department referring to radio-active matter. His paper, "On a Radio-active Substance Emitted by Thorium Compounds," was an introductory of profound significance to those engaged in the higher realms of physical inquiry.

Royal.—Prof. W. Burnside is a voluminous writer on mathematical subjects, particularly on the Theory of Functions (Proceedings, Cambridge Philosophical Society), and the Theory of Groups. Col. David Bruce R.A.M.C., has rendered valuable service in that comparatively new field of inquiry which embraces the study of the causation of tropical diseases, in particular, "Malta" Fever, Tsetse Fly Disease, and Sleeping Sickness, a department of work in which pathology, medicine, and entomology have each a share as agents of discovery and prevention. Ten years ago he was patiently carrying out investigations in Zululand on the diseases "N'gana" and Tsetse Fly. He showed that in character they were identical; further, that the insect known as the tsetse fly was, in reality, the carrier of the parasitical organism (Trypanosome), whose presence entailed pathogenic consequences. This was a new observation, and it marked a long stride forward. As the outcome of researches conducted last year in Uganda, he supplied the proof (removed from conjecture) that Sleeping Sickness, or what is now called Trypanosomiasis, is induced by a microscopic parasite occurring in the blood of the human subject; moreover, that a species of the tsetse fly (*Glossina palpalis*) acts as the carrier of the organism.

Davy.—Prof. W. H. Perkin, jun., was formerly Lecturer and Research Assistant in the Dyeing Department, Yorkshire College, Leeds. He is the author of numerous papers on the colouring matters of plants, especially those of Indian origin. It is, however, for his long-continued and fruitful researches and discoveries in synthetic organic chemistry that he receives the medal.

Darwin.—Mr. W. Bateson's investigation of heredity and variation problems have attracted wide attention. He has redeemed from seclusion the labours of the naturalist Mendel, and directed a large body of workers to the important facts indicated by the studies of that observer.

Hughes.—Sir Joseph Wilson Swan's scientific labours have been concerned principally with the introduction of improvements in the applications of electricity and of the chemical arts in relation to photography. The adoption and development of electricity as a mode of lighting is intimately associated with his invention of the incandescent electric lamp. He was the first to use a filament of carbon. Originator of the autotype process, he has in other directions aided photography in the dual aspects of art and science.

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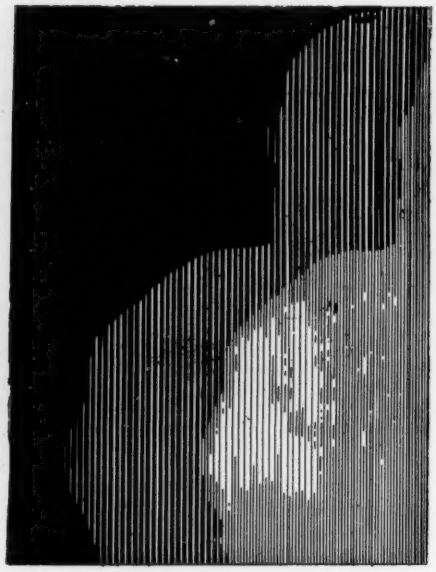
Science at St. Louis.

An exhibition on such a very grand and hitherto unequalled scale might have been expected to have introduced some wonderful novelties to the sight-seeing public, but, as it so happens, no startling new inventions, or specially peculiar constructions, have been forthcoming to add to the attractions at the St. Louis Fair. While speaking of this as an exhibition on an unequalled scale, but little attention from visitors. We shall hope to give a separate and full account of this later on.

On wandering through the vast buildings of Transportation, Electricity, Machinery, and Varied Arts, one eagerly looks for some new and interesting object or contrivance, but in vain. There are huge modern locomotives, interesting models of many old engines, motor cars of all kinds; there are enormous plants for generating electricity, turbine engines, and various methods of electric lighting. Among the latter are two forms still but little known to the English public, the Cowper-

Composite Picture of two Stereoscopic Views, each covering alternate stripes.



Portion of Picture (left hand top corner), enlarged to show system of stripes.

we may quote some figures as giving an interesting summary of the area under roof of shows of a similar nature.

London, 1851	21 acres.
Paris, 1867	37 ,,
Philadelphia, 1876	65 ,,
Paris, 1889	75 ,,
Chicago, 1893	200 ,,
Paris, 1900	145 ,,
St. Louis, 1904	250 ,,

The total area of grounds occupied increased in an even larger ratio, the acreage at St. Louis amounting to some 1240 acres.

The excellent design of the buildings and laying out of the grounds, and the vast number of exhibits render this a truly notable exhibition, and it seems hardly likely that it will be exceeded in the near future. The immense cost is said to be far above the actual profits, which does not augur well for future rivals. Bad luck, or rather lack of good luck, has proved very detrimental to the undertaking, and, notwithstanding the offers of huge prizes for airships and other attractions, no exhibits of special novelty or interest have been acquired. To this statement there is perhaps one exception, and that is in the great solar-heat concentrator being erected by Prof. Himalaya. Yet this apparatus, which may not even prove to be as wonderful as the inventor anticipates, is, towards the end of October, not yet completed, and therefore has attracted Hewitt and the Nernst. But these are hardly to be classed as scientific novelties, and, indeed, are not exhibited as such. The mercury vapour lamp, with its weird blue effects, is to be seen in each of the many photographers' studios, as well as among the illuminations of the grounds. With many exhibits there is a notable lack of proper labelling, and many an interesting object may be passed by unheeded on this account. For instance, the new Edison storage battery is, of course, well to the fore, but though there are a number of them exhibited there is no descriptive account to give particulars, which would, without doubt, be widely read.

A conspicuous feature in the grounds is the tower forming the station of the De Forrest Wireless Telegraph. But we are now getting so accustomed to this form of communication that it excites but little more interest than would an ordinary telegraph office. In the Aëronautical sheds are two or three strange aërial leviathans, though experts seem agreed in not anticipating any very special advance in aërial navigation by their means. Besides various specimens of kites for meteorological work, shown by the Governments of both the United States and Germany, are the models of Prof. Langley's aëroplane machines and a model of the Deutsch airship.

In the Electricity Building are two different instalments of "Wireless Telephone" apparatus. One is the "Radiophone," by means of which sound is conveyed along a

powerful beam of light, and here is certainly an interesting exhibit, although the system has been before the scientific world for some years. From a practical point of view, the invention may seem disappointing, for at the transmitting end a man shut in a sound-tight cupboard blows a loud bugle, the sound of which is conveyed by the searchlight to a distance of only 150 feet, when it is received on a silenium cell, and is very faintly audible in a telephone receiver. The other wireless telephone is on the Miller-Reece-Hutchison system, in which the transmitter is connected with a large coil of wire underground, and the receiving telephone with a coil held in the hand.

Elsewhere exhibits are given of the properties of liquid air and of thermit, extremes of cold and heat which may not be familiar to many visitors.

Of course, several methods of obtaining photographs in natural colours are to be found among the profusion of exhibits. Mr. Cowper Coles shows specimens of electrically deposited metals and the differences of surface obtained by rotating the cores at various high speeds while the coat is forming.

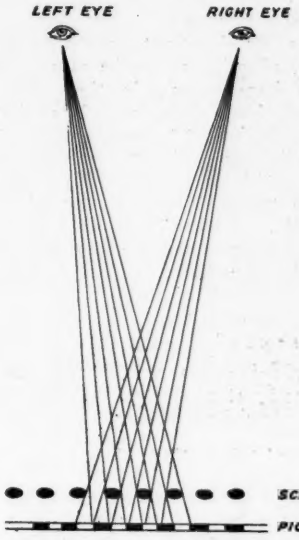


Diagram to show how one eye sees one series of stripes while the other sees only the other series.

The Delaney system of rapid automatic telegraphy is one of the interesting novelties shown. This is a perforated tape machine designed to overcome the tendency existing in other machines of this sort to blur the dots and dashes when sent over a long line. In the perforating apparatus the depression of the key causes a magnet to operate a punch near the upper edge of the tape, while the release of the key brings into operation a punch near the lower edge, so that as the tape is travelling forward the dots and dashes are distinguished by the angular distance of the holes. In the transmitting machine the upper holes give connection to a positive current, while the lower ones give a negative current; so that impulses are sent through the line which are not blurred by the static capacity of the cable. It is said that in laboratory experiments messages have been sent at the rate of 8000 words per minute, and even over lines 1000 miles long a speed of 1000 words a minute has been attained.

A fascinating instrument to watch is the Telautograph, for reproducing at a distance handwriting, sketches, and similar matter—in fact, a "writing telegraph." The transmitting and receiving instruments are so arranged that the pen on the latter moves synchronously with the transmitting pencil. The operation is as follows:—

At the transmitter the sending pencil is attached by two light rods to two lever arms which carry contact rollers at their ends. These contact rollers bear against the surface of two current-carrying rheostats, and the writing currents pass from the rheostats to the rollers, and from them to the line wires.

When the pencil is moved, the position of the rollers upon the rheostats is changed, and currents of varying strength go out upon the line wires.

At the receiver these currents pass through two light vertically movable coils, which are suspended in uniform magnetic fields, and which move up or down against the pull of retractile springs, according to the strength of the line currents. The motion of the coils is communicated to a set of levers of the same length as those in the transmitter. At the junction of the levers is mounted the receiving pen, which by the motions of the coils is caused to duplicate the motions of the transmitting pencil.

The paper is supplied from rolls beneath the transmitter and receiver, and is shifted off the writing platens as it is used.

Another machine worth looking at is a Hydro-Pneumatic Rock Drill in operation, driving holes 1¼ inches in diameter through a lump of solid granite at a rate of nearly 6 inches a minute. This runs at a speed of about 1000 strokes a minute, the length of stroke being about an inch, and the tool being turned 1-11th of a revolution each stroke.

An interesting system of obtaining a stereoscopic effect by means of a lined screen is exhibited, and, as no description of the method seems to have been published before, it may be interesting to describe shortly the general principles involved. It is called the Parallax Stereogram. Two photographs are obtained by twin stereoscopic lenses in the usual way, except that a screen is interposed, formed of fine parallel lines at intervals equal to their thickness (100 to the inch). Each negative will then consist of a series of stripes. The negatives are then exactly superposed so that the stripe left blank on the one coincides with the stripe containing the picture on the other. The resulting image, presenting a most sorry effect, may be seen on opposite page. But if this picture be viewed at a certain distance off, with the screen suitably interposed, the right eye will only be able to see one picture, while the left will only be able to see the other. The result is that the subject appears to stand out in high relief.

THOSE who have a fondness for Nature in her quieter moods and a love for Natural History will find in "Notes of an East Coast Naturalist," by Arthur Patterson (Methuen) a very charming companion and guide. That the author writes with a first-hand knowledge of his subject is evident, both from the originality of his observations as well as from the spirit of enthusiasm which is manifest in every page. His glimpses of the bird-life of the mud-flats, marshes, and sea-shore in the neighbourhood of Great Yarmouth are really delightful. We fully sympathise with the author's sentiment against shooting. Though at one time an enthusiastic gunner, he assures us that he had derived far more pleasure in studying the bird-life of this district by the aid of field-glasses. The short sketches concerning the fish fauna of his neighbourhood are teeming with interest, and contain some shrewd observations well worthy of careful consideration. As much also may be said for his notes on the crustacea of the district. Space forbids a larger notice of this book, but we most heartily recommend it. The coloured illustrations are in many cases extremely good. But for the artist's name on the plates, we should have attributed many of the figures of the birds to G. E. Lodge and A. Thorburn.

The Administration of Chloroform.

THE arrangements for the entertainment of the French doctors last month included a visit to the fine research laboratories that have recently been installed at the headquarters of the University of London, in the building which the University now shares with the Imperial Institute, in South Kensington.

The French visitors were conducted through the various departments of the laboratory by the Director, Dr. Waller, and showed much interest in the work at present going on in electro-physiology, which is made a special feature there. Dr. Waller subsequently demonstrated the graduated administration of chloroform as an anæsthetic.

Since the institution of a Special Committee in 1901 by the British Medical Association to inquire into the administration of chloroform, and cause of the dangers too frequently attending it, various forms of apparatus have been brought forward for the graduated dosage of chloroform. The importance of the subject must infallibly be recognised in view of the too-frequent deaths occurring from chloroform anæsthesia, and of the painful nausea that so often results from its administration. Nor again, is it sufficient that the apparatus shall be "capable of delivering graduated amounts of chloroform under laboratory conditions; that method or apparatus is the safest by which under clinical conditions, and in spite of the unavoidable irregularities due to the anæsthetist or the anæsthetised, greatest uniformity and regularity of chloroform intake shall be maintained."* . . . The two forms of apparatus that conform best with this requisition are the Dubois pump and Waller's wick vaporiser. The former delivers a known volume of chloroform and air, at percentages variable from 1–3 per cent. with gradual and regular induction of anæsthesia, which is easily controlled. This instrument, however, is complicated and expensive. The other and more portable form of evaporator is an ingenious adaptation of the wick carburettor used in certain kinds of motor cars. In overhauling and dissecting a Daimler car, it occurred to Dr. Waller that "if by evaporation from wicks, enough petrol vapour can be got to drive a heavy car at high speed, it should be an easy matter to find a wick surface capable of supplying 1–2 per cent. of chloroform vapour to, say, 10 or 15 litres of air per minute, *i.e.*, in liberal excess of the volume of air normally breathed, which may be reckoned as 5–6 litres per minute. (The average volume of chloroform vapour required is 100–200 cc. per minute; a wick carburettor will afford something like 100 litres of petrol vapour per minute.)"†

The wick vaporiser has been tested clinically at St. George's Hospital, and the principle of dosage by delivery from wicks returning a known strength of chloroform vapour in air proved entirely successful. It should be added that in this and other similar apparatus the percentage delivered is verified by the method invented by Drs. Waller and Geets for *weighing* the $CHCl_3$ vapour.

For laboratory purposes also the wick vaporiser has approved itself. A demonstration of the action of chloroform on cats and rats, with both forms of inhaler, was given by Dr. Waller to the French doctors who visited the Physiological Laboratory of the University of London. The wick vaporiser delivers about $2\frac{1}{3}$ per cent. of $CHCl_3$ and air. The animals invariably go under quietly with no sign of distress or struggle, and recover perfectly, even after prolonged anæsthesia. The treatment may be repeated day after day with no injurious effects, and it is even reported in the laboratory that one kitten contracted the chloroform habit, and pleaded for its daily anæsthetic.

The anæsthesia of small animals up to 10 or 12 kilos in weight is induced in a 15 or 30 litre jar, into which air is pumped through the vaporiser by foot bellows. The anæsthesia is subsequently maintained through the tracheal tube connected with the vaporiser. The depth of anæsthesia is under complete control, the strength of mixture being raised or lowered as required by raising or lowering the wicks of the vaporiser.

FRANCES A. WELBY.

* A. D. Waller, "Examination of Apparatus proposed for the Quantitative Administration of Chloroform."—*Lancet*, July 9, 1904.

† A. D. Waller, Proc. Physiol. Soc., Aug. 19, 1904. Vol. xxxi. *Journal of Physiology*.

Chimpanzis and Gorillas.

By R. LYDEKKER.

THE recent arrival and lamented deaths of the two young gorillas at the Zoological Society's menagerie in the Regent's Park have given rise to a considerable amount of popular interest in these great tropical African apes and their near relatives, the chimpanzis. Accordingly, it is a fit opportunity to devote an article in "KNOWLEDGE AND SCIENTIFIC NEWS" to the consideration of some of the leading characteristics of these two species and their relationship to one another. In referring to these animals as being represented by two species only, I am quite aware that I am going against the views of several of my brother naturalists, who are of opinion that there are several species both of gorillas and chimpanzees. My own opinion, on the other hand (and it cannot be too strongly emphasized that what does or does not constitute a species is merely a matter of opinion, and is, moreover, a matter of little or no importance), is that these so-called species are really local races, or sub-species; and that there are only two distinct types of great African apes, the chimpanzi (*Anthropopithecus troglodytes*), and the gorilla (*Anthropopithecus gorilla*). Here again I fear that I shall be treading on the toes of some of my naturalist friends, who prefer to regard the larger of the two species as representing a genus by itself under the name of *Gorilla;* but from the fact that it is in some cases very difficult to decide whether a particular ape should be classed as a chimpanzi or a gorilla, it appears little short of an absurdity (even admitting that genera, like species, are merely expressions of individual, or it may be collective, opinion) to regard each as the type of a genus by itself. One other point in connection with preliminaries, and I have done. It will be observed that throughout this article the common name of the smaller of the two apes is spelt chimpanzi instead of the familiar chimpanzee. This has been done in order to be in uniformity with the spelling of names like Fiji and okapi, for it is manifest that if we spell such names with a final *i*, we should do the same in the case of chimpanzi and manati. It may be added that the two latter names, like okapi, should probably be pronounced with the accent on the second, instead of on the final, syllable.

Both the chimpanzi and the gorilla are ranked by naturalists among the man-like, or anthropoid, apes, and are the only living African representatives of that group which includes, however, the orang-utan of Sumatra and Borneo, and the gibbons of Assam and the Malay countries. The man-like apes, it may be observed, differ, among features, from baboons and monkeys, by the absence of a tail, of pouches in the cheek for storing food, and of callosities, or hard patches, on the buttocks, as well as by the circumstance that the breast-bone is flattened from back to front instead of from side to side, being, in fact, a depressed instead of a compressed bone, and thus better adapted to permit the free use of the arms in an upright posture. In all these respects, as well as in the structure of the cheek-teeth, which are quite unlike those of monkeys and baboons, the man-like apes resemble man himself; and of all the four existing generic types of the former, the chimpanzi and the

gorilla are the two which approximate most nearly to the human type, the chimpanzi being structurally the nearer of the two to man, although the gorilla marks a step in the direction of the latter by its much less completely arboreal habits. Both the African species are normally black or blackish in colour, and differ strikingly from the orang in that there is no marked and decided difference in the form of the face and head in the two sexes; the male merely showing in this respect an exaggeration of the structural features of the female. In this respect they again show a decided approximation to the human type. For a long period both species were believed to be confined to the tropical forests of the West Coast of the Dark Continent, but the chimpanzi was ascertained by Schweinfurth and Emin Pasha to range into the Niam-niam country and East-Central Africa, and quite recently the gorilla has been found to have a somewhat similar distribution, so that their habitat may be taken to include a large part of the equatorial forest belt. That the ancestor of the group was not, however, a native of Africa may be inferred with considerable probability from the fact that the jaws of a fossil chimpanzi have been discovered in the later Tertiary deposits of North-Eastern India; and it is not a little remarkable that in some particulars the teeth of this extinct Indian chimpanzi come nearer to those of man than do those of either of the two living African man-like apes.

Of the two species, the chimpanzi has been for much the longer time known to European science, Dr. Tyson, a celebrated surgeon and anatomist of his time, having dissected a young individual, and described it, as a pigmy, or *Homo sylvestris*, in a book published so long ago as the year 1699. Of this baby chimpanzi the skeleton is still preserved, and may be seen any day in one of the bays of the central hall of the Natural History Branch of the British Museum alongside the volume in which it is described. It was not, however, till nearly a century later (1788) that the chimpanzi received what is now recognised as a valid scientific name, having been christened in that year *Simia troglodytes* by the French naturalist Gmelin. In his classification it was included in the same genus as the orang-utan, but since such an arrangement scarcely coincides with modern ideas of systematic zoology, it is now generally known as *Anthropopithecus troglodytes*. Whether any stickler after priority will seek to revive Tyson's name, and call the creature *Anthropopithecus sylvestris*, remains to be seen. If he does so, and the change be adopted generally, the chimpanzi would have a much more appropriate designation than it has at present, the "man-like ape which dwells in the woods" being infinitely superior to the "man-like ape which dwells in caves," since the chimpanzi is an arboreal and not a spelæan animal.

As regards the history of the second and larger species, it was at one time supposed that the apes encountered on an island off the West Coast of Africa by Hanno, the Carthaginian, were gorillas, but in the opinion of those best qualified to judge, it is probable that the creatures in question were really baboons. The first real account of the gorilla appears to be one given by an English sailor, Andrew Battel, who spent some time in the wilds of West Africa during and about the year 1590; his account being preserved in Purchas's "Pilgrimages," published in the year 1748. From this it appears that Battel was familiar with both the chimpanzi and the gorilla, the former of which he terms engeco and the latter pongo—names which ought apparently to be adopted for these two species in place of those now universally in use. Between Battel's time and 1846 nothing appears to have been heard of the gorilla or pongo, but in that year a missionary at the Gabun accidentally discovered a skull of the huge ape; and in 1847 a sketch of that specimen, together with two others, came into the hands of Sir Richard Owen, by whom the name *Gorilla savagei* was proposed for the new ape in 1848. Unfortunately Dr. Savage, a missionary at the Gabun, who sent Owen information with regard to the original skull, himself proposed the name *Troglodytes gorilla* in 1847, and this specific name accordingly stands. The first complete skeleton of a gorilla sent to Europe was received at the Museum of the Royal College of Surgeons in 1851, and the first complete skin appears to have reached the British Museum in 1858.

Adult gorillas have never been seen alive in captivity—and probably never will be, as the creature is ferocious and morose to a degree. In addition to the two which made such an unfortunately brief sojourn in the Regent's Park during the present year, a few other immature examples have been brought alive to this country. Of these the following account is reproduced from the "Zoological Notes" column in a recent issue:—

"Only two have, however, been previously exhibited in the Regent's Park. The first of these was a young male, purchased in October, 1887, from Mr. Cross, the well-known Liverpool dealer in animals. At the time of arrival it was supposed to be about three years old, and stood 2½ feet in height. The second, which was a male, and considered to be rather older, was acquired in March, 1896, having been brought to Liverpool from French Congoland by one of the African Steamship Company's vessels. It is described as having been thoroughly healthy at the date of its arrival, and of an amiable and tractable disposition. Neither of these animals suvived long."

So long ago as the year 1855, when the species was known to zoologists only by its skeleton, a gorilla was actually living in this country. This animal, a young female, came from French Congoland, and was kept for some months in Wombwell's travelling menagerie, where it was treated as a pet. On its death, the body was sent to the late Mr. Charles Waterton, of Walton Hall, by whom the skin was mounted in a grotesque manner, and the skeleton given to the Leeds Museum. Apparently, however, it was not till several years later that the skin was recognised by the late Mr. A. D. Bartlett as that of a gorilla; the animal having probably been regarded by its owner as a chimpanzi.

Chimpanzis, on the other hand, are comparatively common in captivity, although most are quite young, and only a few survive to anything approaching maturity.

Between a typical chimpanzi and a typical gorilla there is no difficulty at all in drawing a distinction; the difficulty comes in when we have to deal with the aberrant races (or species) of chimpanzi, some of which are so gorilla-like that it is somewhat hard to decide to which species they really pertain. The ordinary chimpanzi, especially in the young state, is such a familiar animal that a portrait is unnecessary. In height the adult male does not exceed five feet, and the colour of the hair is a full black, while the ears are remarkably large and prominent, and the hands reach only a short distance below the knees. The head is rounded and short, without prominent beetling ridges above the eyes, or a strong crest along the middle line of the back of the skull; while the tusks

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of the old males are of no very great length and prominence. Gentleness and docility are specially characteristic of the species, even when full-grown; while in the native state its habits are thoroughly arboreal.

What a contrast between such a creature and an old male gorilla, one of the most savage and untamable beasts on earth, with the eyes overhung by a beetling penthouse of bone, the hinder half of the middle line of the skull with a wall-like bony ridge for the attachment of the powerful jaw-muscles, and the tusks of monstrous size, and recalling those of a carnivorous animal. These characteristic traits are well displayed in the accompanying photograph (Fig. 1) of the head and bust of a huge male gorilla shot by Mr. H. Paschen in the hinterland of the Cameruns, and now in Mr. Rothschild's Museum at Tring, which also exhibits the relatively small size of the ears and the elongated form of the head distinctive of the gorilla. Another characteristic of this species is the small size of the thumb and the length of the arm, the latter reaching to the middle of the shin-bone.

Fig. 1.—Bust of Male Gorilla from the Cameruns. (After H. Paschen.)

If we had only these two typical forms to deal with, there would be, as already said, no possibility of confounding a chimpanzi with a gorilla. When, however, we pass into Central Africa we find the chimpanzis assuming more or less marked gorilla-like traits which render the distinction in some cases a matter of difficulty. The first of these aberrant types is Schweinfurth's chimpanzi (*Anthropopithecus troglodytes schweinfurthi*), which inhabits the Niam-niam country, and, although evidently belonging to the same species as the typical race, exhibits certain gorilla-like features. These traits are still more developed in the bald chimpanzi (*A. t. tschego*), of Loango and the hinterland of the Gabun and French Congoland, which takes its English name from the sparse covering of hair on the head. The most gorilla-like of all the races is, however, the kulu-kamba chimpanzi (*A. t. kulu-kamba*) of du Chaillu, which inhabits Central Africa. The celebrated ape "Mafuka," which lived for some time in the Dresden Zoological Gardens during 1875, and came from Loango, was apparently a member of the bald race, although it was at one time regarded as a hybrid between a chimpanzi and a gorilla. The gorilla-like features in the head are well displayed in the accompanying photograph (Fig. 2), which was taken immediately after death.

These gorilla-like traits are still more pronounced in the subject of figure 3, which is taken from "Johanna," a female chimpanzi living in Barnum and Bailey's show in 1899; the figure being reproduced from one illustrating a paper on that animal by Dr. Keith. The heavy ridges over the brow, originally supposed to be distinctive of the gorilla, are particularly well marked in "Johanna," and they would doubtless be still more noticeable in the male of the same race, which seems to be undoubtedly du Chaillu's kulu-kamba. Still, the large size and prominence of the ears proclaim that

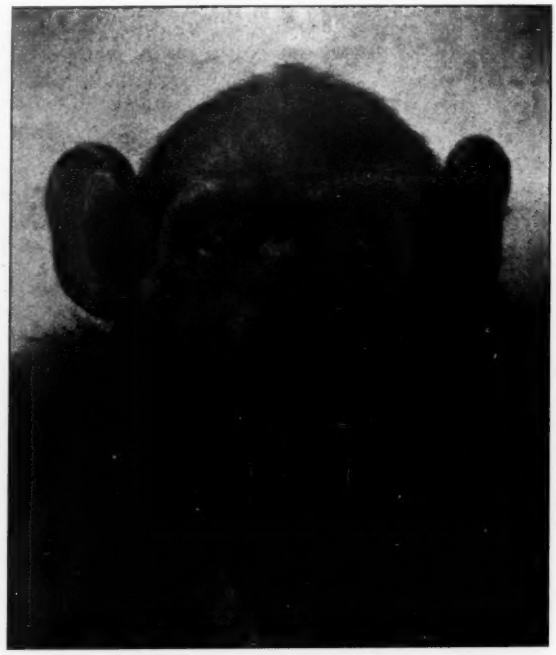

Fig. 2.—Head of Female Kulu-Kamba Chimpanzi "Mafuka." (From a photograph lent by Dr. H. B. Meyer.)

both "Mafuka" and "Johanna" were chimpanzis and not gorillas. A gorilla-like feature in "Johanna" is, however, the presence of large folds at the sides (ala) of the nostrils, which are absent in the typical

Fig. 3.—Female Kulu-Kamba Chimpanzi "Johanna." (From the plate in the Zoological Society's *Proceedings* illustrating Dr. Keith's Memoir.)

chimpanzi, but in the gorilla extend down to the upper lip.

Dr. Keith, who has paid special attention to the subject, is, indeed, of opinion that, in addition to its smaller and flatter ears, the gorilla may be best dis-

tinguished from the chimpanzi by the presence of this great nasal fold running to the margin of the upper lip, by the large size and peculiar characters of the tusks and cheek-teeth; by its broad, short, thick hands and feet, of which the fingers and toes are partially webbed; by the long heel; and by the relative length of the upper half of the arm as compared with the fore-arm. An important distinctive feature of the skull of the gorilla is the great length of the nasal bones. Finally, in life the gorilla is sharply differentiated from the chimpanzi by its sullen, untamable, ferocious disposition.

As regards the relationship existing between the gorilla and the chimpanzi, Dr. Keith's observations are so important and so interesting, that they may be quoted, with a few verbal alterations, at length :—

"An examination of all the structural systems of the African anthropoids leads to the inference that the gorilla is the more primitive of the two forms, and approaches the common parent stock more nearly than does the chimpanzi. The teeth of the gorilla, individually and collectively, form a complete dentition, a dentition at the very highest point of development; the teeth of the chimpanzi show marked signs of retrogression in development both in size and structure. The muscular development and the consequent bony crests for muscular attachment of the gorilla far surpass those of the chimpanzi. The muscular development of the adult chimpanzi represents that of the adolescent gorilla. Some of the bodily organs of the gorilla belong to a simpler and earlier type than those of the chimpanzi. But in one point the chimpanzi evidently represents more nearly the parent form—its limbs and body are more adapted for arboreal locomotion; of the two, the gorilla shows the nearer approach to the human mode of locomotion. On the whole, the evidence at our disposal points to the conclusion that the chimpanzi is a derivative from the gorilla stock, in which, with a progressive brain-development, there have been retrograde changes in most of the other parts of the body. The various races of chimpanzi differ according to the degree to which these changes have been carried."

In conclusion it should be mentioned that four types of gorilla are now recognised by naturalists. Firstly, we have the true *Anthropopithecus gorilla typicus*, of the Gabun, in which the general colour is blackish grey, frequently with a mixture of reddish brown hair on the crown of the head; while very old males take on a whitish grey tinge on the upper portion of the thigh and the lower part of the back. Secondly, there is *A. g. castaneiceps*, which apparently ranges southward to Portuguese West Africa, and has longer hair, with the crown ochre-brown, the back grey, and the limbs blackish. The third form is *A. g. beringeri*, founded on the skull of a male killed near Mount Kirunga, south of the Albert Edward Nyanza, in which the males are bearded. Finally, *A. g. diehli* is known only by a skull from the Cameruns.

"Physiography" (Macmillan and Co.), by T. H. Huxley. This excellent standard work on the introduction to the Study of Nature has been revised, extended, and to some extent re-written by Professor R. A. Gregory, of Queen's College, London. He has done his work with modesty and discretion, and the addition of copious illustrations greatly add both to the usefulness and attractiveness of the book.

CORRESPONDENCE.

Snake Forms in the Constellations.

To the Editors of "Knowledge."

Gentlemen,—In your issue of October, 1904, Mr. Maunder writes as follows: "If we take a precessional globe, move the pole back some 64° or 65° of precession, corresponding, say, to about 2700 B.C., and adjust the globe for N. Lat. 40°—in other words, set it to the time and place when the constellation figures were first defined—what do we find? First of all the Great Dragon . . .

"Next Hydra. Here we have an arrangement even more striking. As fig. 3 will show, Hydra at this time lay right along the equator, extending over about 105°, or seven hours of Right Ascension. Thirdly, Serpens . . . It is scarcely conceivable that this threefold arrangement, which is not suggested by any natural grouping of the stars, should have been carried out as a matter of pure accident. It must have been intentional. For some reason or other—possibly for the simple one that a snake was the animal form that best lent itself to such a purpose—the equator, the colure, the zenith and the poles were all marked out by these serpentine or draconic forms."

Will you allow me space in your columns to re-state an alternative suggestion made by me, concerning the date of the first imagining of the constellation Hydra, in a paper entitled, "Astronomy in the Rig Veda," read in Rome, October, 1899, at the Oriental Congress, and reprinted in my book, "Ancient Calendars and Constellations."

This suggestion would credit the astronomers of old with a recognition of the deeper meanings of an almost universal serpent symbolism; and it is, as it appears to me, more in line with the results of recent archæological discoveries which seem almost necessarily to throw back such symbolism, and with it the dawn of astronomy, to a date much earlier than 2700 B.C.

"On the celestial sphere many serpents and dragons are represented, but the far-reaching constellation Hydra exceeds all the others in its enormous length from head to tail. No very brilliant stars mark the asterism, nor in the grouping of its stars is there anything especially snake-like. For some reason other than its appeal to the eye did astronomers of old invest with all the horrors of the Hydra-form the monotonous length of this space on the vault of the skies.

"This reason may be arrived at, with almost certainty, in studying, with the help of a precessional globe, the position in the heavens of this constellation in different ages of the world's history. So studying, we shall find that 4000 B.C.—or, to be more precise, one or two hundred years earlier—Hydra extended its enormous length for more than 90° symmetrically along one astronomically important (though invisible) mathematical line—the line of the heavenly equator—and was at the same date accurately bisected by another equally important mathematical line, namely the colure of the summer solstice.

"Almost irresistibly, as it appears to me, the conviction forces itself on the mind, in considering the position held by the constellation Hydra 4000 B.C., that it was at that date that this baleful figure was first traced in imagination on the sky, there fitly to represent the power of physical (and may we not suppose also, of moral?) darkness—a great and terrible power—but a power ever and ever again to be conquered by the victorious power of light. In astronomic myth this power was represented as that of the sun at the season of its highest culmination, the season of the summer solstice. For an observer in the temperate northern zone all through the long nights of mid-winter, the whole length of the dreadful Hydra was at the date named visible above the horizon. The dark mid-winter season was therefore the time of the Hydra's greatest glory. At every season of the year, except at that of mid-summer, some portion of the monster's form was visible during some part of the night. But at the summer solstice no star in the constellation might show itself for ever so short a time."

I am, Gentlemen, &c.,

The Oaks, Wimbledon Common. Emmeline M. Plunket.

[The credit belongs to Miss Plunket of having first pointed out that the Hydra was clearly designed by the original constellation makers to mark the equator celestial, and I have no doubt that Miss Plunket's suggested reason is quite correct, namely, that the ancients wished to mark by this great snake the part of the equator which was furthest below the track of the sun. And it lay along the equator approximately both at the date she urges (4000 B.C.) and at that which I put forward (2700 B.C.). Nevertheless the earlier date is inadmissible. The south pole of 4000 B.C. is too far from the centre of the unmapped space in the southern heavens for the work of constellation making to have been completed by that epoch; and, as I have elsewhere pointed out, the traditional figures bear too manifest indications of being items in a single plan for the work to have been done piecemeal, or to have occupied several generations. The earlier date would also displace Serpens and Scorpio from their very significant relation to the colures.—E. WALTER MAUNDER.]

The Cygnus "Coal-Sack."

TO THE EDITORS OF "KNOWLEDGE."

SIRS,—In the Milky Way, a little north of the "Northern Cross"—between the stars ξ and ρ Cygni, in fact—I have frequently observed a black rift cutting the course of the Via Lactea transversely. Do you mind explaining the nature of this phenomenon?

The appearance does not seem to be due to the presence of a dark nebula, because very moderate telescopic aid reveals faint stars in its recesses.

Have we here a veritable opening in our island-universe—a sort of tunnel through which we may peer into the sparsely-lit infinity beyond?

Yours faithfully,
J. B. WALLIS.

Alderwasley, nr. Wirksworth,
Derbyshire,
November 14, 1904.

[The rift to which Mr. Wallis draws attention is clearly shown on Dr. C. Easton's charts of "La Voie Lactée." The phenomenon is doubtless of the same nature as the other numerous rifts, channels, and gaps in the Milky Way; they cannot be due to the interposition of dark absorbing nebulæ, but are evidently integral parts of the Galactic structure.—E. WALTER MAUNDER.]

The Teaching of the Principles of Evolution in the Schools.

TO THE EDITORS OF "KNOWLEDGE."

SIRS,—Over a quarter of a century ago Professor Virchow said: "If the theory of descent is as certain as Professor Haeckel thinks it is, then we must demand its admission into the school, and this demand is a necessary one." I think the time has arrived when all educationists should consider the desirability of teaching children the principles of evolution. I believe all the sects accept the evolution theory, and it would not be difficult to present the facts in such a way that children could understand them.

Yours faithfully,
J. A. REID.

Kincraig, Cutcliffe Grove, Bedford,
November 18, 1904.

REVIEWS OF BOOKS.

Earthquakes.—If it were possible to find a peg for criticism in so admirable a work as Major C. E. Dutton's "Earthquakes in the Light of the New Seismology" (John Murray), it would not be in the book but in the fact that the first general digest of the knowledge and views which are associated with the work and theories of Professor John Milne, Professor Ewing, Professor Nagaoko, of Tokio, Major De Montessus de Ballore, and Dr. Emil Rudolph, of Strassburg, should have been made by an American rather than by an English man of science. However, science is the true cosmopolitan influence, and it behoves us to regard Major Dutton's able, patient, and judicious examination of what the best authorities think and know of a subject which has a fascinating interest for all mankind, as an instance of it. A happy distinction is made in Major Dutton's introduction between the standpoint of the new seismology and the old. The old view of earthquakes was that they were one of those formative geologic forces, almost as mysterious and axiomatic as the occurence of matter itself, which existed in order to bring about structural results. The new view regards earthquakes as merely the effect of geologic forces, just as thunder is an effect of the electric discharge—not the cause of it. As a sound is the elastic vibration of the air, so an earthquake is merely the elastic vibration of the earth mass. Hence the science becomes in a great measure the investigation of elastic wave motion in a solid medium. That investigation became possible with the invention of the seismograph, the earth-tremor measurer; and the correlation of the results which the seismograph afforded was primarily the work of John Milne. He has been followed by hosts of patient investigators in every country of the world; and Major Dutton's book is a summary of the results and conclusions at which they have arrived. His earlier chapters set forth the nature of earthquakes and discuss their double causation, volcanic and "stratagic," if we may coin a word to replace the usual one of "tectonic." Chapters descriptive of the instruments used are followed by others which enter exhaustively into the character, characteristics, and theoretic features of the various kinds of earth tremors or waves which agitate the earth's mass and the earth's crust. Chapter XIII. takes up the question of speed of propagation, its connection with the relation of elasticity to density; and the light which is consequently thrown on the densities of the earth's interior at varying depths. The last chapters indicate the general distribution of earthquakes, and the index they afford of the points of origin of great seismic disturbances, both on land and in the depths of the sea. The volume is one of the most interesting which has appeared in the "Progressive Science Series," and will appeal to a world-wide audience.

"The Mathematical Theory of Eclipses," by Roberdean Buchanan, S.B. (J. B. Lippincott Company, Philadelphia and London, 1904). This work is designed for the computer of solar and lunar eclipses, and not for the use of the practical observer. The author is eminently fitted for his task, as he has been engaged for the last 24 years on the computation of eclipses for the American Ephemeris. The book is based on Chauvenet's chapter on eclipses in his "Spherical and Practical Astronomy," but the great experience of Mr. Buchanan has led him to sift out the unnecessary formulæ from the necessary, and to arrange their order into a more convenient form for computation. A graphic method is also employed for explaining the formulæ:—"The eclipse is dissected after the manner of a surgeon—it is cut up and the hidden parts laid open to view." Mr. Buchanan observed the total eclipse of 1900, May 28, at Newberry, South Carolina, where he gave special attention to the shadow bands, and this feature is the only observational one connected with eclipses with which he treats. The cause of the shadow bands is still doubtful, but Mr. Buchanan is inclined to attribute them to the undulations and disturbances of the density of the atmosphere within the core of the shadow, caused by the lower temperature of the cone (which may fall by 4° or 5°), thus producing intermittent opacity. He also explains the factor producing the "Black Drop" in a transit of Venus or Mercury, and "Baily's Beads" at the second and third contacts of the moon with the sun. He also clearly disposes of the somewhat widely-spread idea that the darkness at the Crucifixion was caused by an eclipse of the sun; this could not be, since a solar eclipse can only occur at new moon, and the Feast of the Passover (upon the eve of which the Crucifixion took place) was appointed by the law to be held at the full moon of the first month.

Chemical Engineering.—A second edition of Mr. George E. Davis's "Handbook of Chemical Engineering" has been published by Messrs. Davis Brothers, of Manchester, and the

necessities of enlargement and revision, which are imposed on such a work by the developments of modern practice and scientific investigation of methods, are very liberally complied with. The ample space of these two volumes, numbering over a thousand pages and comprising more than five hundred illustrations, permits of the most complete examination of the growing requirements of industries which continually show expanding necessities and unbounded possibilities. The volumes, primarily designed for the use of the works manager, are written with a view to be of interest and instruction to the student also. This is the more evident in the second volume, where considerable additions have been made to the theoretical consideration of questions connected with the absorption and compression of gases; and to the application of electricity to the chemical and allied industries. Our space will not permit us to enter into a detailed examination of Mr. Davis's standard of theoretical requirement in the information which he gives on his subjects; but we may note that in the chapters relating to gases and to heat the theoretical side of the questions considered receives treatment which is equally full and lucid. It will be of greater service both to Mr. Davis and to intending purchasers of his valuable volumes to enumerate briefly the new features which have been added to the second edition. In the chapters dealing with steam and power, the subject of water softening has been more fully treated, and the flow of steam through pipes investigated by the light of the latest information on the subject. The flow of viscous liquids through pipes and the cost of moving gases by various methods receive a good deal of attention; and suction producers, the Diesel engine, and the De Laval steam turbine are now fully described. The first volume concludes with a chapter on the treatment and preparation of solids; the second begins with three chapters on heat and the compression and absorption of gases to which we have referred. In connection with the applications of electricity, the electro-smelting furnaces of Stassano, Heroult, Harmet, and Kjellin are both described and illustrated. But perhaps the most important addition to this subject is the information given relating to the comparatively new industry of electro-magnetic separation, which is very fully described and illustrated. All the various systems of magnetic separation have been noticed and many figures of separations from actual practice have been included in the work. Increased attention has also been given to the subjects of hygiene, and especially to accidents and to the treatment of cases of gaseous poisoning. In this connection, the construction and use of respirators has secured additional space, which it is hoped will lead to an extension of knowledge of this important subject.

"The Rob Roy on the Jordan" (John Murray) carries its thirty and odd years lightly. The present eighth (2s. 6d. net) edition of Mr. Macgregor's canoe cruise in Palestine, Egypt, and the waters of Damascus is as fresh as the day it was written. The most interesting point of a narrative that is full of interest is Mr. Macgregor's description of his discovery of the mouth of the Jordan, which "eludes our sight by diving into jungle, where it defies all search from the north side as to where its waters roll into this Lake of Nierom." He found it entering the lake at the end of a promontory of papyrus of the richest green, and upright as two walls on either hand. Apart from the intrinsic interest of the matter the *naiveté* of the style lends it additional charm.

Light and Water.—The luxurious and attractive volume which Sir Montague Pollock calls "Light and Water" (George Bell and Sons) is described by him, in his secondary title, as a Study of Reflexion and Colour in River, Lake, and Sea. It is, in fact, an attempt to state the elementary scientific principles which govern the reflexion of light from water, in such a way as to be a guide to the artist or art student. The book serves its purpose admirably; the simpler laws of optics are stated in terms that are comprehensible to the meanest intelligence, and the author's very agreeable style should commend his book not merely to artists, but to any lover of Nature. Numerous and beautiful illustrations, especially those accompanying the chapters on colour in water, have a value and interest in themselves.

Physical Science.—We must confess to no great predilection for works which summarise in a compressed form half a dozen scientific problems. But an exception must be made in the instance of "The Recent Development of Physical Science," by W. C. D. Whetham, F.R.S. (John Murray), which sets out those questions of gaseous liquefaction, of radio activity, of atoms, electrons, ions, and the ether, the consideration of which has become the theme almost of household discussions. Often books of the kind are very loosely scientific, and, in the attempt to interest, are neglectful of the necessity to instruct. But Mr. Whetham takes a very different view of his responsibilities. He relates the various problems one to the other; he shows what common basis they have; he compares discovery with theory; he interprets the philosophical aspect of scientific endeavour in physical science. To his task of interpretation he brings a pen of singular clearness, and a manner that is graphic, illustrative and succinct. Such an essay may be compared to the best form of public lecture. It demands intelligence on the part of the auditor, but its underlying purpose is to direct that intelligence into channels of greater and more complete information. It would be a very poor compliment to Mr. Whetham to describe his work as popular in the ordinary sense of the expression, but in the better sense, as a book of the greatest utility and interest to the educated public, it may be so considered.

Sociology.—Mr. J. Lionel Tayler's "Aspect of Social Evolution" (Smith, Elder, and Co.) is a suggestive contribution to the new science of Eugenics. It has been more than once pointed out, and that by observers in widely distributed fields of observation, that the improvement of the race cannot be scientifically effected by any scheme that our knowledge can at present propound. There seems, in fact, to be no way of improving the race better than that which was suggested by the late R. L. Stevenson in the words that "one person I have to make good—myself. My duty to my neighbour is better expressed by saying that I have to make him happy—if I can." But at the root of happiness and of goodness lies increased and better knowledge; and in a true appreciation of the difficulties and of the problems is the only hope of the betterment of the race. It is for these reasons that such honest efforts as those of Mr. Tayler to state the problems and the difficulties are to be welcomed.

Natural History.—There is a great deal of charm about Mr. Graham Renshaw's "Natural History Essays" (Sherrat and Hughes), which gather together in a convenient form and in a capitally illustrated book a number of articles on well-known or little animals, typical examples of the mammalian African fauna, such as the Barbary Ape, the Fennec Fox, the Blue Wildebeest, the White Rhinoceros, and that "True Quagga," the extinction of which, though proved, is constantly denied by honest but uninstructed hunters of South Africa. A pleasant gossipy, and withal a sound and valuable book.

Babington's Manual of British Botany.—A ninth edition has been published of the late Professor Babington's "Manual of British Botany" (Gurney and Jackson), which contains the flowering plants and ferns arranged according to the natural orders. The present edition of this useful work, for many years almost the only critical handbook of British flora, has been edited by Henry and James Groves, who have included the notes prepared by its author with a view to a subsequent edition, together with the results of recent work in botany.

Flowering Plants and Ferns.—A second edition in one volume has appeared of Mr. J. C. Willis' useful guide to the students of botany, "A Manual and Dictionary of the Flowering Plants and Ferns" (Cambridge University Press). It is in fact a summary of scientific information about the plants to be found, either in a botanical garden or in the field, and it embraces the subjects of morphology, classification, natural history, and economic botany. It is well adapted both for home study or for work in the country, especially as the descriptions of genera are not unnecessarily technical.

The Timbers of Commerce.—"The Timbers of Commerce and their Identification" (William Rider and Sons), by Hubert Stone, F.L.S., F.R.C.I., consists of an exhaustive tabulation and characterisation of the various woods used in trade. Under the heading of each wood is given its botanical classification, its source of supply, its physical characteristics, its uses in commerce, together with its numerous other qualities, and fine photographs show sections of the principal kinds

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mentioned. In his introduction and chapter on practical hints Mr. Stone speaks of his subject with knowledge and enthusiasm, and it should be a valuable handbook to experts.

Miscellaneous.

Photography.—We have received for review five volumes of the "Photography" Bookshelf series, published by Messrs. Iliffe and Son at 1s. They are intended for practical purposes, are simply written, and sufficiently illustrated. No. 10, "Practical Retouching," containing hints for after treatment of the negative by Drinkwater Butt, F.R.P.S., now appears as a second edition. In No. 15, which deals with "Intensification and Reduction," Mr. Henry W. Bennett considers the methods that experience has proved to be most successful in the process of strengthening or modifying negatives. Nos. 17 and 18, on "Professional Photography," by C. H. Hewitt, contain chapters on such subjects as the Background, Portraiture Outside the Studio, Lighting the Features, and Principles of Composition. No. 5, "Photography in Colours," by R. Child Bayley, F.R.P.S., appears as a second edition.

Malabar and Its Folk (Natesan and Company, Madras), by T. K. Gopal Panik-Kar, B.A., describes the social customs and institutions of Malabar. It contains a good deal of curious and interesting matter, set forth in a quaintly picturesque language, of which the following is a typical example: "Fields laden with heavy corn waving yellow in the tepid breeze, in which the busy day-labourer, basking in the fierce glare of a summer sun, now wipes a brow sprinkled over with drops of honest toil, afford a rare and amusing spectacle. Now chanting his wild notes, now goading and striping the lazy bullocks plodding through the hardened mead, he adds to the amusement of the scene."

The Optics of Photography and Photographic Lenses (Whittaker and Co.; price, 3s. 6d.), by T. Traill Taylor, is published as a third revised edition, with an additional chapter on Anastigmatic Lenses, by P. F. Everitt.

The London University Guide, 1905 (University Correspondence College) contains regulations for the Examinations to be held in 1905-6.

The Matriculation Directory (University Correspondence College, Burlington House, Cambridge) contains the Examination Calendar for 1904-5, with advice as to subjects and textbooks and specimen papers and answers.

The King's English and How to Write It (Jarrold and Sons), by John Bygott and A. J. Lawford Jones.—A practical text-book of essay and *précis* writing appears in a sixth revised edition.

Lectures Scientifiques (Rivingtons), by W. G. Hartog, B.A., of University College, London, supplies a definite want and is admirably arranged. Some familiarity with French and German scientific terms is now essential to all students of science, and more especially so since the University of London has prescribed that a candidate for a scientific degree must be able to read and understand French and German scientific work. "Lectures Scientifiques" consists of extracts from modern French scientific writers on the various branches of science, with a glossary of scientific terms.

One Thousand Objects for the Microscope (Frederick Warne and Co.), by M. C. Cooke, M.A., gives practical hints for the use of the microscope, with lists of objects suitable for mounting. It is written in a pleasant, popular style, with numerous illustrations, and is admirably adapted to the use of the amateur microscopist.

Private House Electric Lighting (Percival Marshall and Co.), by Frederick H. Taylor, is a practical popular handbook designed for the use of the amateur electrician who wishes to acquaint himself with the best modern methods of the installation of electric light in private houses. It is useful and comprehensive.

First Stage Magnetism and Electricity (University Tutorial Press), by R. H. Jude, M.A., D.Sc., appears as a new and revised edition. It is divided into three parts—I., Electrostatics; II., Magnetism; III., Voltaic Electricity—and is designed to meet the requirements of a young engineer.

First Stage Steam (University Tutorial Press), by J. W. Hayward, M.Sc., Vict., is intended to meet the requirements of the Board of Education examination. It includes examples of examination papers from 1901 to 1904, and suggestions for simple experiments, and is illustrated by numerous useful diagrams.

Modern Philosophers and the "Per Quem" (Elliot Stock), by George Edward Tarner, is a conscientious attempt to re-affirm the doctrinal tenets of Christianity, somewhat on the lines of Patey's "Evidences."

The Seven Lamps of Architecture is published by Mr. George Allen in one volume at 3s. 6d. among his reprints of Ruskin's works. This charming little edition is strongly bound, well printed, and beautifully illustrated. Ruskin lovers will gladly avail themselves of this opportunity of obtaining his works at so low a price.

The Museums Journal (Vol. III., Dulau and Company), edited by E. Howarth, forms a useful book of reference, and a compendium of information about museums at home and abroad, while its numerous illustrations afford interesting opportunities of comparing the methods of arranging and exhibiting specimens in English and foreign museums.

The Reliquary and Illustrated Archæologist (Bemrose and Sons), Vol. X., is a delightful possession. Among many of its interesting and elaborately-illustrated articles are "Notes on a Roman Hydraulus," "The Evolution of the Mitre," and "Medallic Portraits of Christ."

We have also received Part VI. of Messrs. Hall and Steven's "School Geometry" (Macmillan), the general principles of the methods of which have already received favourable notice in our columns; and "Elementary Plane Geometry" (Blackie and Son), by Mr. V. M. Turnbull, which proceeds on the Cambridge method of following up the experimental work of measurement and calculation with deductive geometry.

We have received from Mr. John Murray Professor W. H. Pickering's monograph on "The Moon," and Dr. George Newman's "Bacteriology and the Public Health," both of which will be fully noticed in our columns next month. We have also received for review "Light Energy," by Miss Margaret A. Cleaves (Rebman, Limited), which will also be further noticed.

We have also received "Eton Nature Study," by M. D. Hill and W. Mark Webb (Duckworth and Co.)—a book which has every title to attain its desired aim of inculcating the teaching of natural history and botany in schools; and "Nature Teaching," by Francis Walts and W. G. Freeman (John Murray), which aims at teaching botany to the schoolboy from an agricultural and horticultural standpoint. It is excellent alike in aim and plan.

Messrs. Darton's Electrical Novelties.—We have received Messrs. Darton's new catalogue of electrical novelties. The novelties are chiefly of the kind associated with the many uses to which electricity, with its great capacity for sub-division, can be put in the household and the laboratory. The small motors are specially adaptable to such uses; the dynamos and small gas-engines are susceptible of application to larger purposes. Besides these, there are the many varieties of electric lamps with light dry cells which can be used for bedside illumination, for bicycles, or for railway travelling; accumulators for motor-car ignition; electric bells and their accessories; house telephones; medical magnetic coils; induction coils, and other devices of an analogous character.

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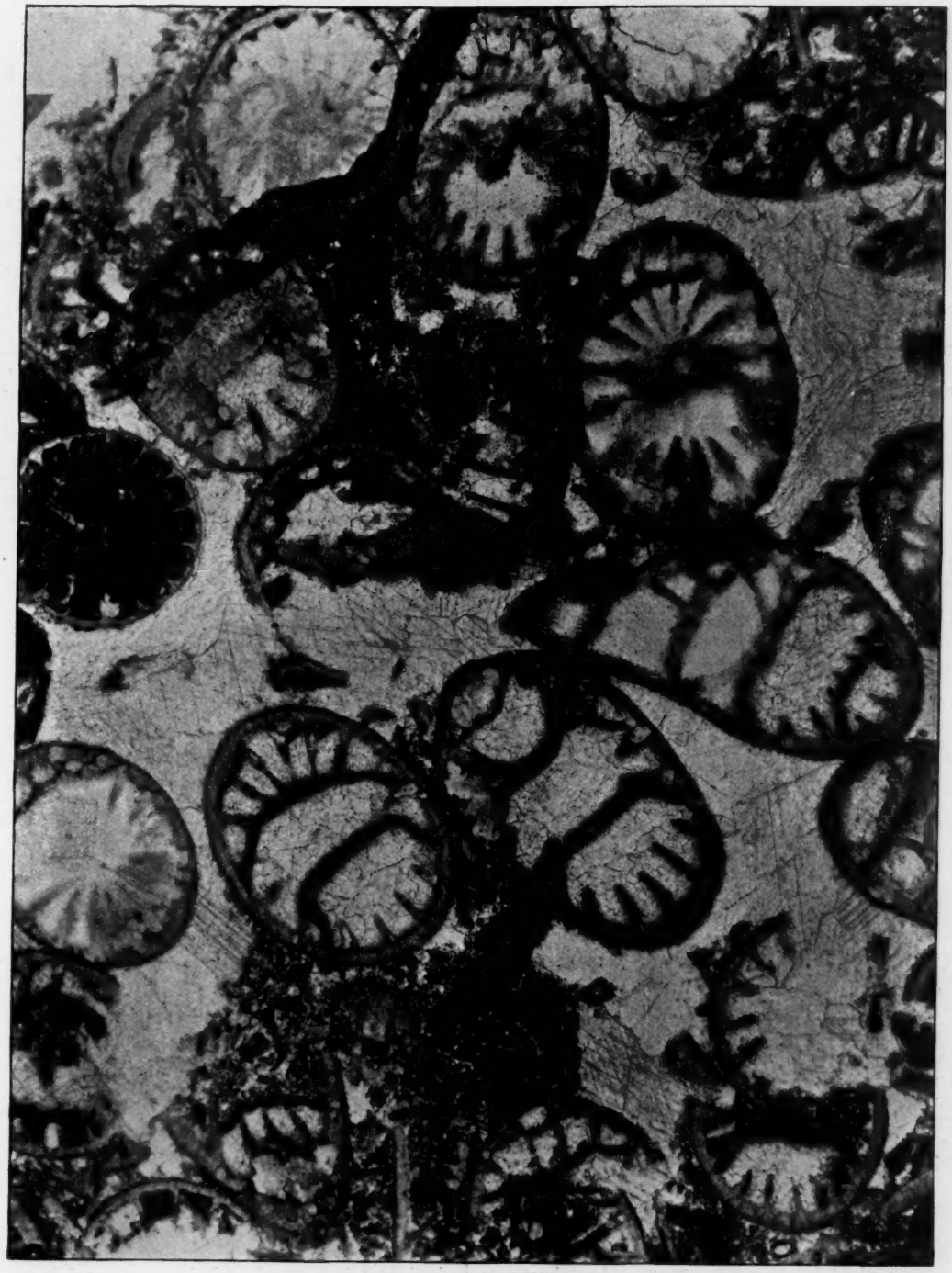
A Microphotograph of Fossil Coal.



THE accompanying Microphotograph of Fossil Coal is one of those with which Mr. Thos. E. Freshwater, F.R.M.S., F.R.P.S., won a Silver Medal this year at the St. Louis International Exhibition, and is reproduced by his courteous permission. The coal of which it is a photograph occurs at Beith, in Scotland; and the photograph was taken on an Ilford ordinary plate, with a *Zeiss* Planar lens, 20 m/m. focus; at an angle of 65 deg., and with a 24-inch extension of the camera.

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MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M S

Royal Microscopical Society.

AT a meeting held on October 19 at 20, Hanover Square, Dr. Dukinfield H. Scott, F.R.S., President, in the chair, Mr. Rousselet described a Lucernal microscope, further portions of which had been presented by Mr. Orfeur. The instrument bore no maker's name, but was built on Adams' model and was probably of a rather later date than his time. A description of this maker's "Improved and Universal Lucernal Microscope" will be found in Adams' Essays on the Microscope, 1787. The Secretary called attention to micro-photographic portraits of Prof. Quekett and two others who were unnamed, but which were identified as being likenesses of Dr. Letheby and Dr. John Millar. A communication from Mr. W. D. Colver was read describing the antenna of *Pulex irritans*, on the terminal joint of which Mr. Wm. Jenkinson, of Sheffield, had discovered a lamellated structure which he believed to have an olfactory function. Mr. Jenkinson had found similar structures in several other members of the family of the Pulicidæ. A slide showing the entire antenna, and another showing the terminal joint, were exhibited under microscopes, and photographs of the latter slide were also exhibited in the room and on the screen. Part xvii., the concluding part of Mr. Millett's Report on the Recent Foraminifera of the Malay Archipelago, was taken as read, and will be duly published in the Society's journal. The President then gave a demonstration on "The Reconstruction of a Fossil Plant." The plant selected was *Lyginodendron Oldhamium*, and the growth of our knowledge of its structure was illustrated by actual sections and lantern slides shown on the screen. The identification of the stem of a Pinites, the fern-like petiole of *Rachnopteris aspera*, and the foliage of *Sphenopteris Höninghausi* as being corresponding parts of Lyginodendron was demonstrated. It was discovered that the stem was frequently branched, and certain fossil seeds are now, on structural evidence and association, considered to be the fruit of this plant. The reconstruction of the plant is, however, still incomplete, as the male organs have not yet been identified with certainty. The position of Lyginodendron as a seed-bearing plant allied at once to Cycads and Ferns was now established. A picture of the reconstructed plant was shown on the screen, and models of the seed, kindly lent by Prof. F. W. Oliver, were exhibited.

The Quekett Microscopical Club.

The 416th ordinary meeting of the Club was held on October 21 at 20, Hanover Square, W. There was an unusually large attendance of members, and the long list of new members proposed for election gave proof of the strong position held by the Club, which will shortly celebrate its fortieth anniversary.

Messrs. W. Watson and Sons exhibited their latest designs and models, both of microscopes and apparatus, together with some very fine slides, principally of marine life.

Mr. F. P. Smith gave a very interesting lecture on the "Spiders of the Erigone group." He described at some length the most striking feature of the sub-Family, viz., the extraordinary formation of the caput in the males. In this sex the caput is almost always of a form different from that of the females, being, as a rule, more or less raised. It was generally thought that such elevation of the caput was intended to extend the field of view, but this seemed doubtful, as the eyes which were placed at the top of the elevation were sometimes so feebly developed that they would gain little or nothing from such elevation. In other species again the eyes were not placed on the summit of the elevation, and in some the elevation was so placed as to obstruct the field of view.

Mr. Smith then dealt with the classification of the group, suggesting a re-arrangement of certain genera and the creation of two new genera for existing species.

Two very old members of the Club, both well known in the microsconical world, have passed away during the last month.

C. G. Dunning joined the Quekett Club in October, 1872, and was on the Committee from 1876 to 1879. He died on September 29. Being of a mechanical turn of mind, he devoted himself to the improvement of microscopical accessories, and invented an improved form of turntable, a portable microscope lamp, and a trough, all of which bore his name, and were in demand in their time, though now superseded by later models.

Edward Dadswell, F.R.M.S., joined the Club in January, 1875, and with the exception of one year, 1882, he served continuously on the Committee from 1879 to 1903. As one of the most familiar figures at the Club, and prominent in its social life and excursions, he will be greatly missed, although he had not been able to attend for more than a year previous to his death. He died on October 6, and the interest which he had always displayed in the Club is marked by a legacy of £50, which he has bequeathed to it in his will.

Staining and Preserving Algae.

J. Q. T. writes from Queensland giving the following particulars of a method of staining and preserving algæ, which he has found very satisfactory. The reagents required are made up as follows:—*Fixing solution:* Chromic acid, 1 oz.; glacial acetic acid, 4 oz.; formaldehyde as formalin (Schering's), 4 oz. *Preserving fluids:* Best glycerine, 8 ozs.; glycerine jelly, 1 oz. *Chromo-acetic acid:* Chromic acid, 1 gramme; acetic acid, 1 cc.; water, 100 cc. *Formalin* (4 per cent.); Schering's formalin, 10 cc.; water, 90 cc. (for a 2 per cent. solution take half the quantity of formalin). *Stains:—Haemalum* (Grübler); *Haematoxylin solution:* Haematoxylin cryst. puriss., 1 gramme; water, 200 cc. *Iron alum solution:* Iron alum, 3 grammes; water, 100 cc. (The iron alum should lie in pale violet crystals, not yellow or green, and should be kept in an air-tight tube.) *Eosin solution* (water soluble): Eosin, 1 gramme; water 200 cc.

The material, which may be "fruiting" or sterile, is gathered in jars and brought home in water, or can be placed directly in the fixing solution at the time of

gathering, this last being generally preferable. If fixed in the chromo-acetic mixture it will require about twelve hours for thorough fixation, and twenty-four hours in the formalin. After chromic acid, the material must be washed in running water or frequent changes for at least one hour, or, better, for three hours. The following simple little piece of apparatus is very useful for washing. It consists of a test-tube fitted with a cork, through which two pieces of glass-tube pass. One of these is connected to a water-tap by a piece of rubber tubing, which, in turn, is connected to a piece of glass tubing passing through a cork jammed in the mouth of the tap. A piece of thin muslin is tied over the end of the other tube inside the jar to prevent the escape of specimens. With formalin no washing is necessary.

The material being fixed, the next question is the stain. If nuclei are the only details required, Haemalum will be the best to use. It should either be used strong for five minutes, or diluted (1 cc. to 50 cc. of water) for twenty-four hours. The staining must be carefully watched in both cases. Overstaining may be remedied by water acidulated (.1 per cent.) with hydrochloric acid, but the method is somewhat risky. The other methods of staining are as follow:—Stain with iron alum solution for three hours, wash in running water for one hour. Stain in Haematoxylin solution for six to twelve hours. Now comes the delicate part, for the tissues are much overstained, and must be washed in the iron solution till the details are brought out, examining with the microscope the whole time. Immediately the details are out (generally in about a quarter-of-an-hour), the decolourisation is stopped by placing the object in tap or rain water. Now place some water in a watch-glass and add 5 per cent. of glycerine. Transfer the algæ to the dilute glycerine and cover it with an inverted watch-glass, to prevent dust without checking evaporation. Leave until the glycerine is thick enough for mounting, mount in a shallow tin cell in just enough glycerine to fill the cell (this requires some practice), seal with gold size, and when dry ring with Brunswick Black. In some cases a contrast stain may be desired. This can be obtained by placing the tissue in the eosin solution for 30 seconds or less, previous to the transference to the 5 per cent. glycerine.

Notes and Queries.

Resolution of Amphipleura pellucida.

Mr. C. Mostyn (of Ramsgate) writes: Your paragraph in "KNOWLEDGE" on resolving Amphipleura induces me to describe a method I have lately hit upon, which may possibly not be known to all microscopists. It has the merit of extreme simplicity, not even requiring a sub-stage condenser, or, in fact, any extra appliance whatever, except a sufficiently powerful source of light, and giving the most brilliant resolution ("false resolution," so called, of course) that I have ever obtained, even with immersions and condensers of great N.A. It happens that my microscope (a "Star") has the very useful fitting of a mirror that can be swung up above the stage for opaque objects. It occurred to me to experiment in the direction of obtaining a "dark ground" or "opaque" illumination with high powers, preferably immersions, by concentrating light on the film of immersion fluid. I tried, among other experiments, a slide of Angulatum, mounted in realgar, with a $\frac{1}{12}$" water immersion, N.A. 1·18, and sunlight. The result was the most beautiful exhibition of the diatom I have ever seen. The diatom, by a little careful handling of the mirror, appeared of a brilliant emerald colour on an ink-black ground—or a light ground could be had at will—and with excellent definition and resolution, free from fog or diffraction effect. This success induced me to try upon Amphipleura and Frustulia Saxonica, both of which were most brilliantly resolved. I fancied I could, on some valves, detect the longitudinal striæ of Amphipleura as well; but the want of a rotation to the stage prevented me from examining the valves in the best manner. I may add that the objectives, with a dry condenser of N.A. 1·0, had hitherto failed to give resolution, try as I would, with or without stops, though an oil lens of N.A. 1·25 would do it easily. I then tried a Zeiss $\frac{1}{20}$"—an old water-lens, whose N.A. does not, I think, exceed 1·10—and it resolved Amphipleura equally well. I have seen many expert hands take half-an-hour to effect a satisfactory display; a minute or two is the outside required with my plan, given a sufficient amount of light. An ordinary microscope lamp, with half-inch wick, is not powerful enough. Of course, a bull's-eye can be used instead of a mirror; but it is not nearly as easy to manage.

I have been told that mine is merely a re-discovery of the "Bramhall Illuminator," but that was a slip of looking-glass placed below the slide, and on a different principle altogether, though, I believe, very effective in the pre-immersion days. I shut off all light from below the slide altogether, with a closed iris.

Galls on Oak-leaves. *H. W. Venton, Handsworth.*

The brown gall on the oak-leaf you sent is a Cynipid gall, that of *Neuroterus lenticularis*. The gall appears in July and matures in September, falling to the ground about the end of that month or the beginning of October. This autumn generation is parthenogenetic, but another and a sexual generation appears in the spring in quite different spherical galls known as *Spathegaster baccarum*. The gall on the midrib of the same leaf is *Neuroterus ostreus*, whilst the gall with a depressed centre on the other oak leaf is *Neuroterus numismatis*, which matures with *N. lenticularis*. These and many other galls were exhibted by Mr. E. R. Burdon, of Sidney Sussex College, at the last meeting of the British Association held in Cambridge, and Mr. Burdon has been good enough to name the above species for me. You will find the subject dealt with in "Alternating generations; a biological study of oak-galls and gall-flies," by Hermann Adler, translated by C. R. Straton, and published by the Clarendon Press in 1894. In this book you will find instructions as to rearing the flies—the eggs themselves can be easily dissected out if you wish to do so. I do not think you could turn your attention to a more interesting branch of study or one offering more opportunities for original work, as the whole subject has been neglected by all but a very few workers.

John Hume, Newcastle-on-Tyne. The gall you sent is that of *Neuroterus lenticularis* mentioned above.

H. W. Harvey, Norfolk. What you thought to be a fungus is the same gall. With regard to the "second sting" you speak of, the drawing you send is not sufficient to enable me to pronounce an opinion, but these stings are generally made of a couple of darts which join together so as to form a canal down which the poison passes into the wound. Is it not possible that you have split one of these, or even damaged their sheath, and so formed an erroneous impression?

Derivation of Names of Diatoms.

Rev. W. Hamilton Gordon, of Fareham, Hants, would be glad if any reader could give the derivation of the names *Surirella* and *Nitzschia* as applied to diatoms. I think there can be no doubt that the latter diatom was named after the worm of the same name, but that does not bring one much nearer. With regard to the distribution of diatom material, I am dependent entirely on the generosity of such readers of my notes as have material of one sort or another which they are good enough to send me for distribution to others.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," 51. Barnabas Road, Cambridge.*]

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The Face of the Sky for December.

By W. Shackleton, F.R.A.S.

The Sun.—On the 1st the Sun rises at 7.45, and sets at 3.53; on the 31st he rises at 8.8, and sets at 3.58.

Winter commences on the 22nd, when the sun enters the sign of Capricorn at 6 a.m. Solar activity is well marked, and sunspots, faculæ, and prominences may be observed on any favourable occasion.

For physical observations of the sun the following ephemeris may be used:—

Date.	Axis inclined from N. point.	Centre of disc, N or S of Sun's equator.
Dec. 1 ..	16° 6′ E.	0° 38′ N
,, 11 ..	11° 56′ E.	0° 38′ S
,, 21 ..	7° 19′ E.	1° 54′ S
,, 31 ..	2° 30′ E.	3° 6′ S

The Moon:—

Date.	Phases.	H. M.
Dec. 7 ..	● New Moon	3 46 a.m.
,, 14 ..	☽ First Quarter	10 7 p.m.
,, 22 ..	○ Full Moon	6 1 p.m.
,, 29 ..	☾ Last Quarter	3 46 p.m.

Occultations.—

Date.	Star's Name.	Magnitude.	Disappearance.			Reappearance.		
			Mean Time.	Angle from N point.	Angle from Vertex.	Mean Time.	Angle from N point.	Angle from Vertex.
			p.m.			p.m.		
Dec. 20..	γ Tauri	3·9	6.1	90	130°	7.4	239°	275°
,, 20..	θ′ Tauri	3·9	11.25	145°	130°	11.58	195°	173°
			a.m.			a.m.		
,, 21..	α Tauri ..	1·1	3.19	57°	17°	4.12	295°	255°

The Planets.—Mercury is an evening star in Sagittarius, setting about an hour after the Sun until the 25th; he attains his greatest easterly elongation of 20° 30′ on the 14th. The planet is in inferior conjunction with the Sun on the 31st.

Venus is rapidly coming into a more favourable position, and towards the end of the month is well visible in the evenings. On the 1st she sets about 6.15 p.m., and on the 31st about 7.45 p.m. The apparent diameter of the planet is increasing, being 15″ on the 15th, whilst 0·75 of the disc is illuminated.

Mars is a morning star in Virgo, rising about 1.38 a.m. on the 15th.

Saturn is getting more to the west and also diminishing in brightness. About the middle of the month the planet is on the meridian at sunset, and sets about 8.15 p.m. The ring is widely open, the diameters of the major and minor axis of the outer ring being 37″·1 and 9″·7 respectively, whilst the polar diameter of the ball is 14″·8.

Uranus is unobservable, being in conjunction with the Sun on the 22nd.

Neptune rises about 9 p.m. near the middle of the month. He is situated about 14 mins. east of the star μ Geminorum, as will be seen on reference to the chart given in the January number. The planet is in opposition on the 28th, hence about this time he souths near midnight.

Jupiter is in a very favourable position for observation in the early evenings, being on the meridian about 8 p.m. near the middle of the month; also throughout the month he is visible from sunset until early morning.

The equatorial diameter of the planet on the 15th is 45″, whilst the polar diameter is 2″·9 smaller.

The configurations of the satellites, as seen in an inverting telescope at 9 p.m., are as follows:—

Day.	West. East.	Day.	West. East.
1	1○324	16	3○124
2	3○124	17	312○4
3	321○4	18	32○14
4	32○14	19	● 1○24
5	● ○$^{4}_{3}$2	20	○1234
6	41○23	21	● 2○43
7	42○13	22	12○43
8	● 41○3	23	43○12
9	43○12	24	4312○
10	43$^{2}_{1}$○	25	432○1
11	432○1	26	413○2
12	● 41○2	27	4○123
13	4⊙23	28	● 42○3
14	2○$^{3}_{4}$	29	4$^{3}_{2}$○3
15	● 1○34	30	$^{3}_{4}$○12
		31	31⊙4

The circle (○) represents Jupiter; ⊙ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc, or in the shadow. The numbers are the numbers of the satellites.

Meteors:—

The principal shower of meteors during the month is the Geminids, December 10th to 12th; the radiant is in R. A. VIII.^{h} 12^{m}, Dec. + 33°. The meteors are short and quick, and difficult to record accurately.

Encke's Comet was again photographed by Max Wolf on October 28, when its magnitude was 12·5.

The comet is increasing in brightness, being in perihelion on Jan. 4, hence it should be visible in ordinary telescopes early in the month; after the first few days, however, the Moon and the comet's motion into daylight will make observation impossible.

The following ephemeris is for Berlin noon.

Date.	Right Ascension.	Declination.
	h. m. s.	° ′
Dec. 1 ..	21 13 11	+ 9 35·1
,, 2 ..	21 9 31	9 0·0
,, 3 ..	21 5 51	8 24·6
,, 4 ..	21 2 11	7 48·9
,, 5 ..	20 58 32	+ 7 13·0

Minima of Algol may be observed on the 1st at 10.22 p.m., on the 4th at 7.11 p.m., 7th at 4.0 p.m., 22nd at 0.5 a.m., 24th at 8.54 p.m., and 27th at 5.43 p.m.

Telescopic Objects:—

Double Stars:—1 Pegasi XXI^{h} 17.5^{m}, N.19° 20′, mags. 4·5, 8·6; separation 36″·2.

π Andromedae 0^{h} 31.5^{m}, N. 33°·11′, mags. 4·0, 8·0; separation 36″·3.

α Piscium 1^{h} 56.9^{m}, N. 2°·17′, mags. 3·7, 4·7; separation, 3″·6

ι Trianguli II^{h} 6.6^{m}, IV. 29°50′; mags. 5, 6·4; separation 3″·5.

Clusters:—(H VI. 33, 34). The Perseus clusters visible to naked eye and situated about midway between γ Persei and δ Cassiopeiæ. These magnificent clusters are described by Smyth as "affording together one of the most brilliant telescopic objects in the heavens."